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DEVELOPMENT OF PREDICTION MODELS TO MEASURE VENDOR PERFORMANCE IN SURVEILLANCE AND AUDITING OF AIRCRAFT MAINTENANCE

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DEVELOPMENT OF PREDICTION MODELS TO MEASURE VENDOR PERFORMANCE IN SURVEILLANCE AND AUDITING OF AIRCRAFT MAINTENANCE

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ABSTRACT

Elimination of aviation accidents is one of the primary goals of the Federal Aviation Administration (FAA) and the airline industry. A leading cause of aviation accidents is lack of oversight of various organizational issues, in particular, the organization's maintenance operation performance. The technologies used in the industry generate multiple risks, mostly from three domains: systems, hardware and people. Maintenance performance analyses identify the inherent risk in distributed, large-scale systems. Analysis of existing aviation maintenance data is a crucial step in meeting the aviation industry's need to improve aviation safety. Presently, we lack suitable tools to analyze large bodies of maintenance data. In this study, we generate models responsive to airline operation requirements using hierarchical logistic regression analysis based on historical auditing and surveillance data. These models helped to determine the organizational factors underlying aviation maintenance errors, ultimately helping airline personnel to manage the surveillance and auditing functions of aircraft maintenance. Three models were generated- one model each for an airline's technical audit, internal audit and surveillance work functions. These models were embedded in a web-based surveillance and auditing tool (WebSAT). Validation experiments were conducted to evaluate the utility of the model in WebSAT. Results indicated that there is significant improvement in vendor/ department performance prediction capabilities when the model is employed with WebSAT. The auditors and surveillance representatives' ability to understand the effect of a change in the level of a predictor on rejection rate improved significantly

when the model was employed in WebSAT. The technical audit and surveillance managers' non-significant results indicate that the Audit Allocation and Surveillance Planning tools are not as useful for managers. It is important to improve the capabilities of the planning tools by employing more variables in the regression models including information on surveillance representatives and auditors.

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CHAPTER I: INTRODUCTION

The FAA's strategic plan (2001) sets the following long term goals for aerospace safety: "By 2007, reduce U.S. aviation fatal accident rates by 80% from 1996 levels". The frequency of accidents can be greatly reduced by minimizing aircraft maintenance errors. This demands an overall assessment of an airline's performance. Research in the domains of human error classification and cognitive modeling has led to the development of error analysis methods and human factors interventions that enhance aircraft safety (Rasmussen, 1986; Reason, 1990; Shappell and Wiegmann, 1997). Error classification schemes (W. B. Rouse and S. H. Rouse, 1983; Patankar, 2002) are useful to identify weaknesses in a system, when supported by comprehensive investigation procedures. The primary focus of these studies is error classification to facilitate prevention, not monitoring error frequency and occurrence. The latter is crucial, given the enormity of aviation maintenance operations.

The aircraft maintenance process involves a number of stakeholders who ensure the airworthiness of the aircraft, while adhering to the regulatory standards, policies and procedures of the FAA. The complexity of this structure entails significant information flow. Little research has been conducted on the management of the data available from the various aircraft maintenance processes. As safety is the chief concern of the aviation industry, it is critical to analyze the available data. Such analysis capability requires an appropriate data collection strategy to identify sources of improper maintenance and risk-related factors influencing aircraft safety.

This research proposes to develop models for analyzing the maintenance data from an air transport company. The results of this study will enable prediction and identification of improper aircraft maintenance. Further, this study will identify the various causes of poor maintenance. Together, these analyses will provide valuable information, such as error trends specific to a fleet type/ vendor/ maintenance unit, helping the airline's management to mitigate risk by modifying the influential factors.

The Literature Review chapter describes current research in the aviation industry and presents the problem statement and objectives of the research. The Multilevel Logistic Regression Analysis chapter describes the concept of multilevel logistic regression. The Logistic Regression Model Generation chapter presents the model analysis, its results and discussion. The Interface Design and Evaluation chapter describes the interface of the tool used to present model and the interface evaluation and model experiments. The results and discussion of the experiments conducted are presented in the Experiment Results and Discussion of Experimental Results chapters, respectively. The Conclusions and Recommendations chapter describes the conclusions and implications of the research. Finally the Appendices and References sections present the supporting data and citations made in the body of the manuscript.

CHAPTER II: LITERATURE REVIEW

2.1 Research in the Aviation Industry

Few human industrial endeavors dedicate such vigorous energy, concentrated attention and allocation of resources to safety as the air transportation industry (Johnston, McDonald and Fuller, 1994). The airworthiness of an aircraft is determined by the humans working with the aircraft, such as maintenance technicians and pilots; machines, such as the aircraft and its various systems and technologies; and external factors, such as weather and political environment.

The literature on human error has its foundations in studies of pilot errors and human reliability, along with the development of error taxonomies (McKenna, 2002; Rasmussen, 1982; Reason, 1990; W. B. Rouse and S. H. Rouse, 1983). These studies have focused on analyzing the interaction of humans with aircraft and their involvement in maintenance accidents. Further, the aviation maintenance industry has invested a significant effort in developing methods for studying maintenance errors. Research on aviation maintenance has also investigated issues pertaining to the performance of the inspector and the aviation maintenance technician (AMT) and their training. These studies have devised several training strategies: on site, computer-based and in a virtual reality environment (Nickles, Marshall, Gramopadhye and Melloy, 2001). Other studies have looked at the characteristics of the inspector, such as age, fatigue and cognitive abilities and their effect on the performance of the highly demanding inspection task, where errors have a severe impact on aircraft safety ("FAA Human Factors in Aviation Maintenance", 1991). According to Baker, Lamb, Grabowski, and Reebok (2002), between 70% and 80%

of today's aviation accidents can be attributed to human error. There are a number of human error measuring techniques such as the technique for human error rate prediction (THERP) (Swain and Guttmann, 1983), success likelihood index method (SLIM) (Zimolong, 1992) and errors of intention method (INTENT) (Gertman, Blackman, Haney, Seidler and Hahn, 1992). All of these methods assess human error probabilities, based on structured expert estimates.

The significance of the maintenance function was captured by Weick, Sutcliffe, and Obstfeld, (1999) when they observed that: "Maintenance people come into contact with the largest number of failures, at earlier stages of development, and have an ongoing sense of the vulnerabilities in the technology, sloppiness in the operations, gaps in the procedures, and sequences by which one error triggers another". Maintenance error has been found to be a crucial factor in aircraft accidents. Given the ever increasing complexity of an aircraft, a significant proportion of these errors come at the hands of the maintenance personnel themselves, due to greater demands on these individuals (FAA, 1991). Empirical models have been developed to illustrate how the parts of the system work to influence outcomes; e.g., the Maintenance Error Decision Aid (MEDA) (Rankin, Hibit, Allen, and Sargent, 2000) helps analysts identify the contributing factors that lead to an aviation accident. However, MEDA is dependent on the erring technician's willingness to be interviewed about an error. Anything that would decrease this willingness, such as a fear of being punished for the error, would have a detrimental effect on MEDA implementation. Further, this approach, like many others, is initiated after an accident has occurred.

Taylor and Thomas (2003) used a self-report questionnaire called the Maintenance Resource Management/ Technical Operations Questionnaire (MRM/TOQ) to measure what they regarded as two fundamental parameters in aviation maintenance: professionalism and trust. The dimension of professionalism is defined in their questionnaire in terms of reactions to work stressors and personal assertiveness. Trust is defined in terms of relations with co-workers and supervisors. Patankar (2003) constructed a questionnaire called the Organizational Safety Culture Questionnaire which included questions from the MRM/TOQ along with items from questionnaires developed outside the maintenance environment. Following the application of exploratory factor analytic routines to a dataset generated from respondents that included 124 maintenance engineers, Patankar identified four factors as having particular relevance to the safety goals of aviation organizations: emphasis on compliance with standard operating procedures, collective commitment to safety, individual sense of responsibility toward safety, and a high level of employee-management trust. The use of MRM/TOQ is claimed to benefit both special training programs and efforts to establish attitude – performance linkages in aviation ground operations.

Recently, figures emerging from the United Kingdom Civil Aviation Authority reveal a steady rise in the number of maintenance error mandatory occurrence reports over the period 1990 to 2000 (Courtney, 2001). McKenna (2002) states that the FAA, in its strategic plan for human factors in aviation maintenance through 2003, cited statistics from the Air Transport Association of America (ATA) showing that the number of passenger miles flown by the largest US airlines increased 187% from 1983 through 1995. Over that same period, the number of

aircraft operated by those airlines increased 70%, but the number of AMTs increased only 27%. The FAA concluded that the only way the maintenance program could cope with the increased workload was by increased efficiency at the worker level.

2.2 Risk in Large Scale Systems

Risk can be based on a number of factors in complex systems, such as inherent risk associated with the activity (e.g., mining, surgery, air transportation) (Grabowski and Roberts, 1999). Risk is also caused by individuals and organizations executing or coordinating the tasks using technology. Organizational structures in a system may unintentionally encourage risky practices (e.g., the lack of formal safety reporting systems, and organizational standards which can only be met with some risk taking). Organizational cultures may support risk taking or fail to sufficiently encourage risk aversion (Grabowski, Merrick, Harrald, Mazzuchi and Dorp, 2000; La Porte and Consolini, 1991; Perrow, 1984; Roberts, 1990; Tenner, 1996; Thomson, Onkal, Avicioglu and Goodwin, 2004; Weick, 1993).

Aviation maintenance personnel face pressures to get an aircraft back into service as quickly as possible. Thus, the pressure of time is a reality for most maintenance personnel. A particular risk is that maintenance personnel faced with real and self imposed time pressures will be tempted to take shortcuts to get an aircraft back into service more quickly. Lack of knowledge or experience is one of the most obvious local factors resulting in maintenance errors. Most maintenance personnel have had the experience of carrying out new tasks without being entirely sure whether they were doing them correctly. Such trial-and-error performance is by definition unreliable. Men violate more rules than women and the young violate more than the old (Reason and Hobbs, 2003). Consequently, it is necessary to

identify variables, such as maintenance operator characteristics, which may directly contribute to the risk prevalent in the system.

2.3 Nature of Current Systems

Current systems in the field of aviation maintenance analyze accidents to understand maintenance errors and their occurrences. The data collected with these accidents are used to identify their causes. Further, these causes are classified using established error classification schemes such as HFACS (Shappell and Wiegmann, 1997). Other systems, such as MEDA (Rankin, Hibit, Allen, and Sargent, 2000), use questionnaires to identify the causes of an aviation accident. There is a need for empirically validated models that capture data on maintenance work and provide a means of assessing this data prior to dispatch of the aircraft.

2.4 Existing Models in Industry

Several models available in industry today assist with risk and error measurement. In general, they can be broadly classified into:

1. Human error measurement techniques: THERP (Technique for human error rate prediction), SLIM (Success likelihood index method) and INTENT. These methods assess human error probabilities based on structured expert estimates (Gertman et al., 1992; Zimolong, 1992).
2. Failure identification techniques: FMEA (Failure modes and effects analysis), CCA (Cause-consequence analysis) and MORT (Management oversight risk tree). These techniques determine problems that could arise from system malfunction and involve analyzing each potential problem point (Andrews and Moss, 1993; Aven, 1992; Suokas, and Rouhiainen, 1993). They use a combination of fault tree and event tree analyses incorporating probabilities

of various events to calculate consequence probabilities. These techniques are time consuming and require a detailed understanding of the process.

3. MESH (Managing engineering safety and health): MESH was created by British Airways in the early 1990s and was later adapted by Singapore airlines. It is a system measuring the effects of specific variables on task performance. These variables are not intended to be comprehensive listings. Assessments are made through subjective ratings of the extent to which the variables have been a problem in relation to a small number of jobs, days or tasks. On completing their ratings, the assessors are provided with a profiled summary of their own input together with a cumulative profile of all ratings made over the past four weeks (Reason and Hobbs, 2003).
4. Trend estimation and prediction models: This technique has received attention in the time series literature, especially when the interest is focused on forecasting turning points. Despite differences, one common feature among the various forecasting methods is that trends tend to extrapolate themselves into the future as a line with a slope that depends on information from the recent past. The general analytical approach is to collect a measure over multiple instances in time. The change in the measurement over time identifies a global linear or non linear pattern that may be used to understand the underlying trend in data.

   Multiple regression models are often used in practical decision making problems where the goal is to forecast an outcome based on data that were collected earlier. Human decision making is often biased and influenced by more recent experiences. The role of human judgment and the factors

associated with "fallibility" in decision-making have been the central facets in many areas of human performance research (Guion, 1998; Dorsey and Coovert, 2003). Further, in the absence of prior research or theory, regression models can be used in a purely exploratory fashion to identify a collection of variables that strongly predict an outcome variable (J. Cohen, P. Cohen, West, and Aiken, 2003).

2.5 Surveillance, Auditing, Airworthiness Directives

The surveillance, auditing and airworthiness directives groups constantly monitor and evaluate the level of compliance of the airline. The findings of the representatives in these groups help in the evaluation and assessment of the internal and external organizations associated with the airline, which influences the safety and airworthiness of aircraft. Dharwada, Iyengar, Kapoor, Gramopadhye, and Greenstein (2004) defined and described the aforementioned work functions in detail.

The maintenance carried out on an airplane by AMTs is overseen by the airline owning the airplane. Such oversight is referred to as surveillance. Surveillance is the day-to-day oversight and evaluation of the work contracted to an airframe substantial maintenance vendor to determine the level of compliance with the airline's Maintenance Program and Maintenance Manual. On a regular basis, the FAA issues Airworthiness Directives (ADs) in the United States. An AD may require inspection, replacement, or modification of a part, prohibit a type of operation, or mandate some other action. They are usually issued based on accident investigations or service difficulty reports. The Airworthiness Directives Control Group is responsible for AD compliance. Auditing may be performed at two levels- Internal and Technical audits. Internal audits are those that are performed within and/or

across the airline departments. Oversight of functions relating to aircraft line maintenance, ramp operations and aircraft fueling, whether owned by the airline or contracted to a vendor, is accomplished by a formal system of technical audits performed by certified technical auditors.

A majority of airlines outsource their maintenance requirements to outside vendors. Heavier maintenance or C-Check is less expensive when it is performed by lower-paid mechanics working for outsourcers. FedEx, UPS, JetBlue, Southwest, America West, Northwest and United are among the carriers that outsource major maintenance of their aircraft to contractors in other countries (reported in Consumer Affairs, "Airlines outsourcing more maintenance," 2005). Further, air carriers have expanded their use of external repair facilities and now outsource 53% of their aircraft maintenance expenses to outside repair facilities, up from 47% in 2003. This requires the airlines and the FAA to be vigilant of airline maintenance operations (Thomson et al., 2004).

2.6 Web- based Surveillance and Auditing Tool (WebSAT)

It is important that the effectiveness of surveillance, airworthiness directives and auditing be closely monitored. There are no current systems in place which use the data generated by these work functions to assess their performance. To address this requirement, Dharwada et al., (2004) are developing a Web based Surveillance and Auditing Tool, WebSAT. This will allow users at various hierarchical levels in a work function to collect data on surveillance, auditing and airworthiness directives operations.

2.7 Problem Statement

Statement 1: As stated earlier, the complexity of the aircraft maintenance process entails significant information flow. However, little research has been conducted on the management of the data available from the various aircraft maintenance processes. Considering the various processes which directly or indirectly affect aircraft safety, merely performing oversight and managing data may not be sufficient for achieving safer skies. It would be useful to analyze the data to see what affects maintenance and auditing operations. The lack of tools to collect and analyze the data involved in surveillance, airworthiness directives, and audits prevents the airline from identifying risks.

Statement 2: Further, given the increasing need for airlines to work with vendors to meet their maintenance requirements, the capability to assess vendor performance would be advantageous. Such capabilities will allow airlines to assess the quality and understand the inherent risks involved with their work functions.

2.8 Objectives of the Study

The objective of this research is to analyze surveillance and auditing processes by integrating models into the WebSAT tool. Due to the unavailability of historical data, analysis on airworthiness directives will not be conducted in this research study.

This research aims to:

1. Develop a method to generate models for the surveillance and auditing work functions.

2. Adopt the method to develop one or several models that can be integrated into WebSAT.
3. Implement the models in WebSAT. These models will allow WebSAT to predict the substantial maintenance vendor/ audited vendor/ audited department's performance over a period of time and thereby allow the audit / surveillance representative to be aware of the substantial maintenance vendor/ audited vendor/ audited department's limitations.
4. Use the models to identify the sources of changes in predicted response rate. This information can be used by the surveillance representative or auditor to determine what is causing lower/higher predicted performance levels.
5. Validate the models experimentally by testing with representative users at a partnering airline.

CHAPTER III: MULTILEVEL LOGISTIC REGRESSION ANALYSIS

A broad class of regression models, collectively know as the generalized linear model (McCullagh and Nelder, 1989), have been developed to address multiple regression with a variety of dependent variables, *Y*, such as continuous values, categorical (e.g., dichotomies) and counts. The most common is the ordinary least squares regression (OLS) model. Like OLS, all the other regression models can be expressed in a form that is linear in the parameters. Individual predictors may be functions of other predictors, as in polynomial regression where the predictor variables are powers of other predictors or the predictor variables may include interactions represented as products of other predictors.

However, unlike OLS, the errors of prediction, or residuals, in other forms of regression analyses are not normally distributed and, thus, fail to exhibit homoscedasticity or equal variance for all predicted values of Y in the population. Further, unlike OLS regression, in these methods of regression analysis the scale of the predicted score is not the same as the scale of the criterion; put another way, predicted scores are not in the same units as the observed Y.

When data contains variables which are embedded inside another variable, it exhibits a hierarchical pattern of data distribution called clustering. For example, one county has several districts and each district has several schools. When data is clustered, OLS regression may lead to inaccuracies in inference. The random coefficient model or the multilevel model, an alternative to OLS analyses, is structured to handle clustered data. Multilevel analyses are increasingly being used to generate models for hierarchical measures.

The multilevel model provides accurate estimates of the relationships of predictors at each level to a dependent variable, while at the same time taking into account clustering and providing accurate estimates of the standard errors of the regression coefficients (J. Cohen, P. Cohen, West, and Aiken, 2003). These models assume that there are at least two levels in a data set, an upper level, or "level 2," and a lower level, or "level 1." The level 1 data is nested within level 2 (Kenny, Korchmaros and Bolger, 2003). For example, a researcher may collect demographic background, parenting practices, and educational achievement data on all school children in a sample of schools (Raudenbush and Bryk, 1986). In this example, schools are the level 2. This data may include characteristics of the schools such as location and size. The data for each school within a level are called groups. The school children are persons nested within each school and form entries in the data. These individual entries in each group are referred to as cases (level 1). The cases may have their own characteristics (e.g., age and race of the child) which will be included as level 1 data. Thus, in this example, the children within a school group are the cases (level 1) in that group (level 2).

Typically, multilevel models are broken down into two sets of equations (Raudenbush and Bryk, 2002) – the level equations and the mixed model equation. The equations below consider a two level structure for simplicity. The level 1 equation in these models will follow the generic form of equation 1.

$$y_{ij} = B_{1j}x_{ij} + B_{0j} + r_{ij} \qquad (1)$$

where y_{ij} = the value of the response variable for case i in group j

B_{1j} = level 1 regression coefficient (B_1) in group j

B_{0j} = level 1 regression intercept (B_0) in group j

x_{ij} = the value of the predictor variable for case i in group j

r_{ij} = the level 1 error for case i in group j

Thus, this equation includes only one predictor variable x_{ij} to predict y_{ij}. The level 2 or macro level equations express how the set of level 1 intercepts for each cluster (B_{0j}) and the level 1 slopes (B_{1j}) relate to the intercept and slope of the overall population regression equation. The population regression equation is a single regression equation that fits the overall population from which the data has been collected. In other words, the level 2 model describes the relationship of each group to the population. The common notation from multilevel modeling uses γ_{00} (gamma zero zero) for the population regression intercept and γ_{10} for the population regression slope. The relationship of the intercept B_{0j} in each group to the population intercept γ_{00} is shown in equation 2. The level 2 model for the regression slope is shown in equation 3. The level 2 equations characterize the group structure inherent in the data, as noted in the subscript for each group. The clustered nature of the data is captured by the level 2 equations.

$$B_{0j} = \gamma_{00} + u_{0j} \quad (2)$$

$$B_{1j} = \gamma_{10} + u_{1j} \quad (3)$$

where u_{0j} = random deviation of the intercept of group j from overall population intercept.

u_{1j} = random deviation of the slope or regression coefficient of group j from overall population regression coefficient.

The presentation of the multilevel model thus far makes it appear that the level 1 and level 2 equations are treated separately. In fact, they are combined to form a single regression equation (equation 4) referred to as the mixed model

because it "mixes" the two levels, in that it contains terms from both the level 1 and level 2 models (J. Cohen, P. Cohen, West, and Aiken, 2003).

$$y_{ij} = (\gamma_{10} + u_{1j})x_{ij} + (\gamma_{00} + u_{0j}) + r_{ij} \quad (4)$$

If the dependent variable, *Y*, is dichotomous, as when a response variable is in the form of "Yes" or "No", the residuals from OLS regression of the dependent variable do not satisfy the OLS assumption of homoscedasticity or normal distribution of the errors. For such types of data, logistical regression analysis is used. The outcome for each case will be dummy coded as Y =1 for case (e.g., receiving a response as "Yes" for an audit) and Y = 0 for non case (e.g., receiving a response as "No" for an audit). The probability distribution associated with a dichotomous variable *Y* is a binomial distribution. The proportion *P* of scores for a dichotomous dependent variable such as audit responses is the mean of the distribution. In logistic regression, the predicted score is not itself dichotomous; we are not predicting if someone is in a case versus a non case. Rather we are predicting the probability in the population of being a case. One of the forms of simple single variable logistic regression is expressed in equation 5.

$$\ln\left(\frac{\hat{p}_i}{\left(1-\hat{p}_i\right)}\right) = B_1 x_i + B_0 \quad (5)$$

where $\hat{p}_i$ = predicted probability of being in case i.

B_1 = regression coefficient or slope for predictor x_i

B_0 = regression intercept

The right hand side of equation 5 is referred to as logit, the logistic probability unit. The logit is the function of the predicted probability $\hat{p}_i$ that is linearly related to the predictor X.

$$\log it = \ln\left(\frac{\hat{p}}{(1-\hat{p})}\right) \quad (6)$$

For example, imagine predicting the probability that an assistant professor is promoted to associate professor as a function of publications (J. Cohen, P. Cohen, West, and Aiken, 2003). A fictitious logistic regression equation of the form of equation 5 predicting the logit of promotion is given as

logit (promotion) = B_1 (publications) + B_0

= 0.39 (publications) – 6.00,

where B_1 = 0.39 and B_0 = - 6.00.

The data from an audit or surveillance activity is dichotomous in nature such as "Yes"/ "No". Further, the possible predictor variables follow a clustered structure. For example, in the case of audits, the auditor or vendor may represent level 2. Level 1will include all the audit types and audit durations embedded in level 2. Similarly in the case of surveillance, the substantial maintenance vendor receives several aircraft and often surveillance representatives are rotated to different vendor sites. Thus vendor forms level 2 while level 1 includes aircraft characteristics like it age and fleet type.

This suggests the use of a multilevel and logistic regression model. A multilevel logistic regression model uses the multilevel and clustering analysis capability of a multilevel regression analysis technique with the capability to deal with dichotomous dependent variables in logistic regression.

CHAPTER IV: LOGISTIC REGRESSION MODEL GENERATION

4.1 Model Generation Experiment

Hypothesis: The following hypothesis was tested in this experiment:

H_0: There is no effect of the model to predict audits and surveillance events composed of response variables listed in Table I.

H_a: There is a significant effect of the model to predict audits and surveillance events composed of response variables listed in Table I.

Independent Variables: The independent variables are factors such as the vendor location and auditor experience that may significantly affect vendor/department performance. Some of the independent variables, in the context of surveillance, measured in this research, may include age, and work experience of the Quality Assurance Representatives (QARs); the aircraft fleet type, size, age and make; and the vendor age, experience, location, period of service, type of service and number of employees. Table II provides the definitions of the different variables that are believed to affect performance in the three work functions.

Dependent Variables: The response variables (see Table I) that determine the effectiveness of the vendor/ department performance, such as the proportion of the number of Yeses in the case of audits and the number of rejects that occurred during the surveillance of a scheduled maintenance were measured in this study. This proportion or the probability of Yes is referred to as the response rate in case of audits and the probability of rejects for surveillance is referred to as the rejection rate.

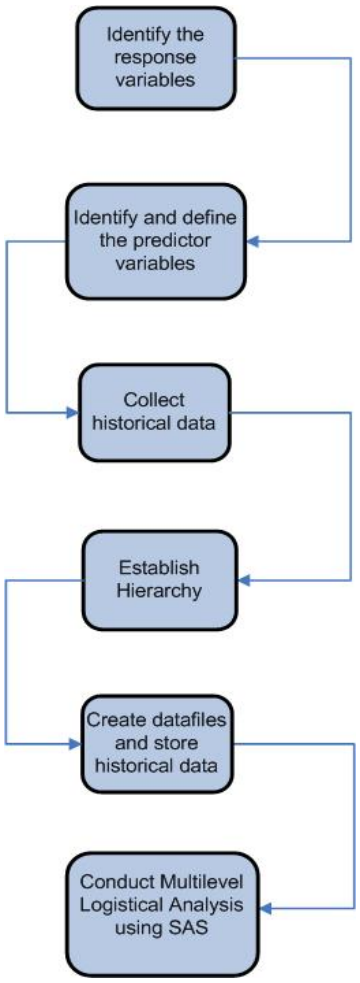
Method: The methodology proposed for this research, as shown in Figure I, involves the following steps:

1. Identification of the response variables (dependent variables) to be used in the data analysis process. The response variables for the three work functions are listed in Table I.

Table I. Response Variables for Data Analysis

No.	Work Function	Response Variable
1	Technical Audit	"Yes" audit responses
2	Internal Audit	"Yes" audit responses
3	Surveillance	Work card Rejects

Figure I. *Research Methodology*



2. Identification of various predictor variables that contribute to variance of the response variable for each of the three work functions. The first step in selecting variables was to identify the different possible levels in the data. For auditing, the possible levels were the vendor/ department characteristics (e.g., location, type of business and age of business), auditor characteristics (e.g., experience and age) and the audit characteristics (e.g., audit type and process measure categories). Similarly, for surveillance, the possible levels were vendor characteristics (e.g., location, type of business, age of business, number of airline representatives and experience of airline representatives), aircraft characteristics (e.g., aircraft manufacturer, aircraft type and age of the aircraft) and the surveillance activity characteristics (e.g., process measure categories). The levels and their characteristics may have some effect on the maintenance performance of the vendor/ department. As cited earlier in the literature review chapter of this dissertation, some of these variables will help us evaluate the effect of the local factors, mentioned by Reason and Hobbs (2003), on maintenance performance. The identified variables for the three work functions are shown in Table II.

Table II. *Definition of Identified Predictor Variables*

Work Function	Predictor Variable Type	Predictor Variable	Variable Definition
Surveillance	Quality assurance representatives' (QAR) characteristics	Age	Age of the QAR.
		Gender	Gender of the QAR.
		Work experience	Work experience of the QAR at the airline company and in the field.
	Aircraft characteristics	Fleet type	The different aircraft models.
		Fleet size	Number of aircraft of a

Work Function	Predictor Variable Type	Predictor Variable	Variable Definition
			particular fleet type.
		Age	Number of flight hours flown by the aircraft.
		Company	The manufacturing company of the aircraft.
	Vendor characteristics	Age of vendor company	Number of years the vendor has been in the business.
		Location	Geographical location of the vendor such as city, state and country.
		Average experience of employees	Employee experience refers to the experience gained by the AMTs working for the vendor.
		Number of hangars	Number of hangars owned by the vendor at the maintenance facility.
		Number of inspectors	Number of inspectors working for the vendor.
		Period of service	The period for which the airline has been in business with the vendor.
		Number of representatives	Number of QARs stationed at the vendor facility.
		Type of service	Fabrication / "C" check / "B" check
		Number of employees	Number of the employees working for the vendor.
		Average employee age	Average age of employees working for the vendor.
		Number of airline customers	Average number of airline companies the vendor does business with per year.
	Process measures	Process measures types	Surveillance is conducted on the work

Work Function	Predictor Variable Type	Predictor Variable	Variable Definition
			cards of a scheduled maintenance event accomplished by a vendor at its facility. The data obtained from the surveillance process will be grouped into categories to facilitate further data analysis and describe the effectiveness of the surveillance process. These categories are defined as process measures. They are In Process, Verification, Final Walkaround, Documentation, Facility and Procedures and Manual Violation Surveillances.
Technical Audit	Auditor characteristics	Age	Age of the auditor.
		Gender	Gender of the auditor.
		Work experience	Work experience of the auditor at the airline company and in the field.
	Audit characteristics	Audit type	The different types of audits.
		Time taken to complete an audit	Time taken to complete an audit
		Number of auditors	Number of auditors who conduct the audit at the vendor facility.
	Vendor characteristics	Age of vendor company	Number of years the vendor has been in the business.
		Location	Geographical location of the vendor such as city, state and country.
		Average experience of employees	Employee experience refers to the experience gained by the employees working for

Work Function	Predictor Variable Type	Predictor Variable	Variable Definition
			the vendor.
		Number of service orders annually	Service orders are the orders placed by the airline with the vendor. The annual number of service orders shows the amount of business carried out by the vendor with the airline company.
		Number of audit types	The different types of business that the vendor carries out with the airline.
		Period of service	The period for which the airline has been in business with the vendor.
		Number of employees	Number of the employees working for the vendor.
		Average employee age	Average age of employees working for the vendor.
		Number of airline customers	Average number of airline companies the vendor does business with per year.
	Process measures	Process measures types	The data collected from the technical audit checklists will be grouped into categories to facilitate further data analysis and describe the effectiveness of the technical audit process. These categories are defined as process measures. They are Compliance and Documentation, Inspection, Facility Control, Employee Training, Procedures, Data Control and

Work Function	Predictor Variable Type	Predictor Variable	Variable Definition
			Safety.
Internal Audit	Auditor characteristics	Age	Age of the auditor.
		Gender	Gender of the auditor.
		Work experience	Work experience of the auditor at the airline company and in the field.
	Audit characteristics	Audit type	The different types of audits.
		Time to complete an audit	Time taken to complete an audit
		Number of auditors	Number of auditors who conduct the audit at the department.
	Department characteristics	Age of department	Number of years the department has been in the airline.
		Location	Geographical location of the department such as city, state and country.
		Average experience of employees	Employee experience refers to the experience gained by the employees working for the department.
		Number of audit types	The different types of business that the department carries out with the airline.
		Number of employees	Number of the employees working in the department.
		Average employee age	Average age of employees working in the department.
	Process measures	Process measures types	The data collected from the internal audit checklists will be grouped into categories to facilitate further data analysis and describe the effectiveness of the internal audit process.

Work Function	Predictor Variable Type	Predictor Variable	Variable Definition
			These categories are defined as process measures. They are Administration, Manuals, Procedures, Training, Records and Safety.

3. Historical data on the predictor and response variables was collected for the three work functions. This data was made available in various formats, such as CDs and paper documents. It was not practically feasible to collect data on all the predictor variables, due to issues such as data accessibility and confidentiality.

   With respect to the above mentioned predictor variables, data were collected on some of the variables from a partnering airline. The predictor variables provided by the airline for analysis are illustrated in flow charts presented in Appendix A, B and C for the Technical Audit, Internal Audit and Surveillance work function respectively.

4. The predictor variables must be arranged in a hierarchy such that the lowest level will represent the most often changing element(s), such as the response variables collected during an audit. The hierarchies of the variables collected for Technical, Internal Audits and Surveillance are shown in Appendix D.
5. Data files were created to store the collected data.
6. A Statistical program, SAS, was used to perform a multilevel logistic regression analysis of the historical data for the three work functions of technical audits, surveillance and internal audits. To enable SAS to analyze

the data, translation of the historical data into numerical codes was performed. For example, for the technical audit analysis, categorical variables such as audit type were dummy-coded by SAS as seen in Table III. Dummy-coding is essential as this allows SAS to use the categorical variables in the data. Dummy coding a variable creates a set of indicator or dummy variables to represent the information in a categorical variable. Thus, as seen in Table III, the categorical variable Audit Type with four levels was converted into four dummy variables.

Table III. *Data Coding for Audit Type in Technical Audits*

Audit Type (SAS)	**Actual Audit Type**
Atypecode1	Fuel
Atypecode2	Line
Atypecode3	Ramp Operations
Atypecode4	Supplier

Continuous variables such as auditor experience and audit duration are "mean-centered" (i.e., reported relative to the mean across the entire 15,972 entries for technical audit data). This addresses problems with the estimation of the intercept. Because the 0 values will fall in the middle of the distribution of the predictors, the intercept estimates will be more meaningful at the means of the independent variables. The nested structure adopted for the data is presented in Appendix D. The resulting models developed from the analyses, predict an audit response rate for Technical and Internal Audit and a rejection rate for Surveillance. In the context of audits, the response rate generated by the models is the probability of receiving a "Yes" for an audit question. The analysis determined the predictor variables that

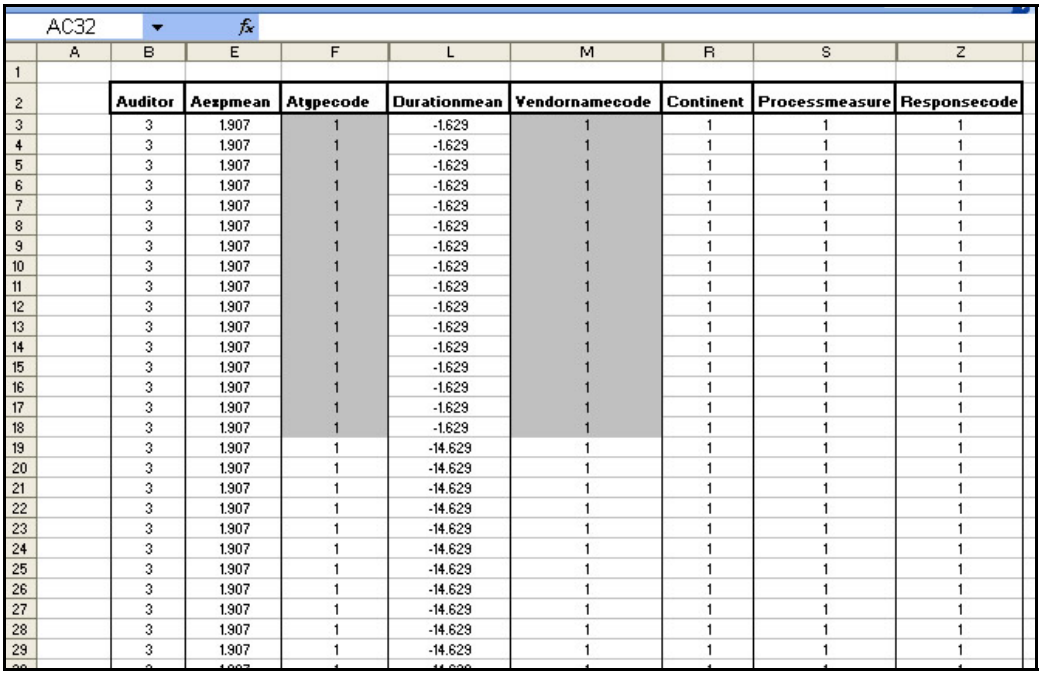
significantly affect the response variables listed in Table I. Further, the analysis generated regression models involving the significant predictor variables.

Results and Discussion: The methodology provided above was adopted to generate the models for technical audit, internal audit and surveillance which are presented in the subsequent sections.

4.2 Technical Audit Model Generation

To conduct logistic regression analysis, the data file (see Figure II) and the SAS procedure statements in Figure III were used. Figure II is a screenshot of the Excel data file containing the technical audit data. The details of the data are provided in the following pages as I explain the SAS output.

Figure II. *Screenshot of Technical Audit Data File*



AC32

	A	B	E	F	L	M	R	S	Z
1									
2		Auditor	Aexpmean	Atypecode	Durationmean	Vendornamecode	Continent	Processmeasure	Responsecode
3		3	1.907	1	-1.629	1	1	1	1
4		3	1.907	1	-1.629	1	1	1	1
5		3	1.907	1	-1.629	1	1	1	1
6		3	1.907	1	-1.629	1	1	1	1
7		3	1.907	1	-1.629	1	1	1	1
8		3	1.907	1	-1.629	1	1	1	1
9		3	1.907	1	-1.629	1	1	1	1
10		3	1.907	1	-1.629	1	1	1	1
11		3	1.907	1	-1.629	1	1	1	1
12		3	1.907	1	-1.629	1	1	1	1
13		3	1.907	1	-1.629	1	1	1	1
14		3	1.907	1	-1.629	1	1	1	1
15		3	1.907	1	-1.629	1	1	1	1
16		3	1.907	1	-1.629	1	1	1	1
17		3	1.907	1	-1.629	1	1	1	1
18		3	1.907	1	-1.629	1	1	1	1
19		3	1.907	1	-14.629	1	1	1	1
20		3	1.907	1	-14.629	1	1	1	1
21		3	1.907	1	-14.629	1	1	1	1
22		3	1.907	1	-14.629	1	1	1	1
23		3	1.907	1	-14.629	1	1	1	1
24		3	1.907	1	-14.629	1	1	1	1
25		3	1.907	1	-14.629	1	1	1	1
26		3	1.907	1	-14.629	1	1	1	1
27		3	1.907	1	-14.629	1	1	1	1
28		3	1.907	1	-14.629	1	1	1	1
29		3	1.907	1	-14.629	1	1	1	1

As seen in Figure III, the Proc Glimmix statement invokes a SAS procedure. The Class statement instructs the procedure to treat the variables Vendornamecode,

Atypecode, Processmeasure and Continent as categorical variables which are then dummy-coded by SAS. Note that the variables Responsecode, Vendornamecode, Atypecode, Processmeasure and Continent refer to Audit Response, Vendor, Audit Type, Process Measure and Continent respectively. The Model statement names the dependent variable and the fixed effects or the independent variables.

Figure III. *SAS Procedure used for Technical Audit Model Generation*

```
Proc Glimmix method = mspl;
Class Vendornamecode Atypecode Processmeasure Continent;
Model Responsecode (event ='1' ) = Aexpmean Atypecode Durationmean
 Continent Processmeasure
Aexpmean*Atypecode Aexpmean*Durationmean
Aexpmean*Continent Aexpmean*Processmeasure Atypecode*Durationmean
Durationmean*Continent Durationmean*Processmeasure
Continent*Processmeasure Aexpmean*Durationmean*Processmeasure
Aexpmean*Durationmean*Continent*Processmeasure
/ s dist= binary;
Random intercept / sub = Vendornamecode;
Title 'Vendor Technical Audits' ;
 Run;
```

The Distribution option, displayed as "dist" in Figure III, determines how the Glimmix procedure models probabilities for the data. The Random statement specifies that the linear predictor contains an intercept term that randomly varies at the level of vendor effect. In other words, a random intercept is drawn separately

and independently for each vendor in the study. The output information generated from the Glimmix procedure is explained in the subsequent pages.

The Model Information Table in Table IV summarizes important information about the model and the estimation technique. Proc Glimmix recognizes the response variable Responsecode with a binary distribution. The estimation technique is maximum subject pseudo-likelihood (MSPL).

Table IV. *Technical Audit Model Information*

Model Information	
Data Set	WORK.NIKHIL
Response Variable	Responsecode
Response Distribution	Binary
Link Function	Logit
Variance Function	Default
Variance Matrix Blocked By	Vendornamecode
Estimation Technique	PL
Degrees of Freedom Method	Containment

In Table V, the Class Level Information table lists the levels of the variables specified in the Class statement. The Number of Observations table (See Table VI) displays the number of observations read and used in the analysis. There is a difference in the observations read and observations used as those sample points having missing auditor experience data were excluded from the analysis. This is also the reason for some missing levels in the variable "Vendornamecode." There are four variables listed in the Class statement. Table VI shows that for this analysis, 15972 sample points were provided of which 14267 sample points were utilized for the model generation.

Table V. *Technical Audit Class Level Information*

Class Level Information		
Class	**Levels**	**Values**
Vendornamecode	70	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 21 22 23 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 74 75
Atypecode	4	1 2 3 4
Processmeasure	7	1 2 3 4 5 6 7
Continent	3	1 2 3

Table VI. *Technical Audit Number of Observations*

Number of Observations Read	15972
Number of Observations Used	14267

Table VII shows information about the fit of the generalized linear models (GLM). The log pseudo likelihood reported in the table is the residual log likelihood for an approximated model and is the fit of the model in representing the data. The generalized chi-square statistic is analogous to the residual sum of squares in the final model and the ratio with its degrees of freedom is a measure of variability of the observation about the mean model. Typically, the ratio between the Generalized Chi-Square and its degrees of freedom should equal one in GLMs. Values approaching two or more are indicative of inability of the model to represent the variability in the data. With a ratio of 1.01, the model appears to exhibit a good fit.

Table VII. *Technical Audit Fit Statistics*

Fit Statistics	
-2 Log Pseudo-Likelihood	96087.47
Generalized Chi-Square	14465.81
Gener. Chi-Square / DF	1.01

The Type III Tests of Fixed Effect displays significance tests for the five fixed effects and 10 interaction effects in the model (see Appendix E). The five main effects were not found to be significant ($p > 0.05$). However, the two way interactions of auditor experience and location of the vendor (Aexpmean*Continent), audit duration and audit type (Durationmean * Atypecode), and audit duration and vendor location (Durationmean * Continent) are significant ($p < 0.05$). The three way and four way interactions were not significant. In Appendix F, the parameter estimates table displays the maximum likelihood estimates, standard errors, and t tests for the hypothesis that the estimate is zero (i.e. the predictor variable has no effect on the response rate). The estimates in this table form the coefficients of the corresponding variables in the model. The p in the column Pr>|t| shows if the difference in the levels of a categorical variable to its reference level are significant. For example, the audit type 2 (line audits) displayed as Atypecode2 is significantly different from audit type 4 (Supplier audits) displayed as Atypecode4 ($p = 0.044$), as seen in Appendix F.

The significant interaction effects were analyzed. To understand the interaction between two variables, A*B, the response variable is measured at one level of one variable, say A, for various levels of the other variable, B. If variable A is a continuous variable such as auditor experience, the levels it is set at are decided using the variable's mean and standard deviation (say SD_A). Thus, if B is a categorical variable, the interaction between the two variables, A*B, will be measured by calculating the response variable value at the mean of variable A for the various categorical levels of B. Similarly, the response variable value at one standard deviation above the mean of variable A ($A + SD_A$) and one standard deviation below

the mean of variable A (A - SD_A) for the various categorical levels of B shows the interaction of A* B at two other levels of A.

Figure IV displays the two way interaction of auditor experience with continent (p = 0.0003). To evaluate the two way interaction of auditor experience with continent, the response variable was measured at one level of the auditor experience for various levels of continent. The auditor experience mean from the historical data is 7 years with a standard deviation of 2.5 years. Observing the chart we can conclude that for the same auditor experience there is a difference in the response rate for the American, Asian and European continents. The auditor experience particularly affected the response rate for vendors located on the American continent.

Figure IV. *Auditor Experience and Continent Interaction*

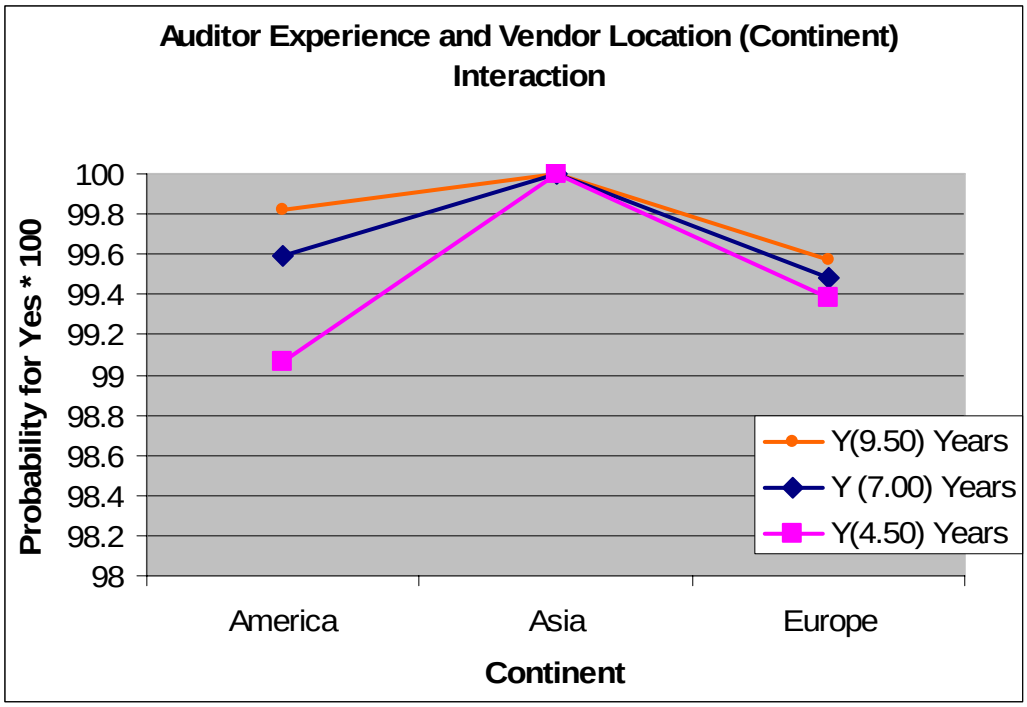


Figure V displays the two way interaction of audit duration with audit type (p = 0.0005). The response variable was measured at one level of the audit duration for

various levels of audit types. The audit duration mean from the historical data is 32.63 days with a standard deviation of 30.7days. Observing the chart we can conclude that there is a difference in the response rate only at audit duration of about 63 days by audit type. Particularly for supplier audit type, the longer the audit, the lower the response rate.

Figure V. *Audit Duration and Audit Type Interaction*

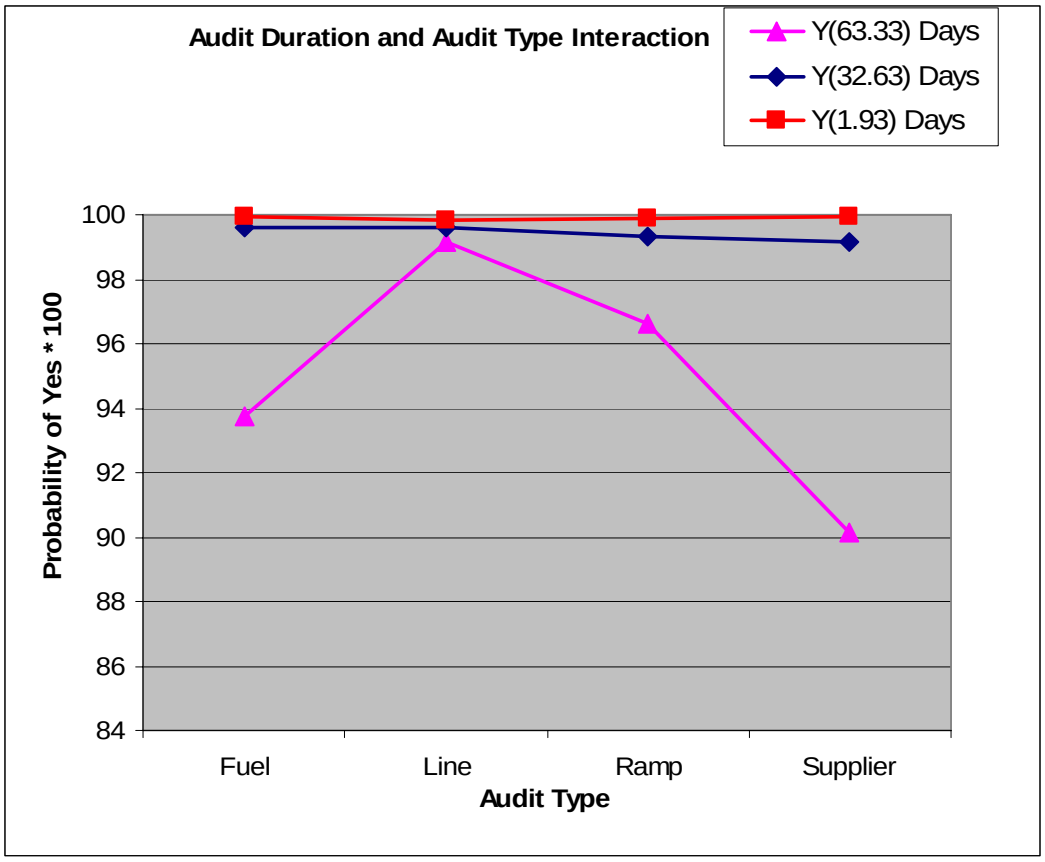
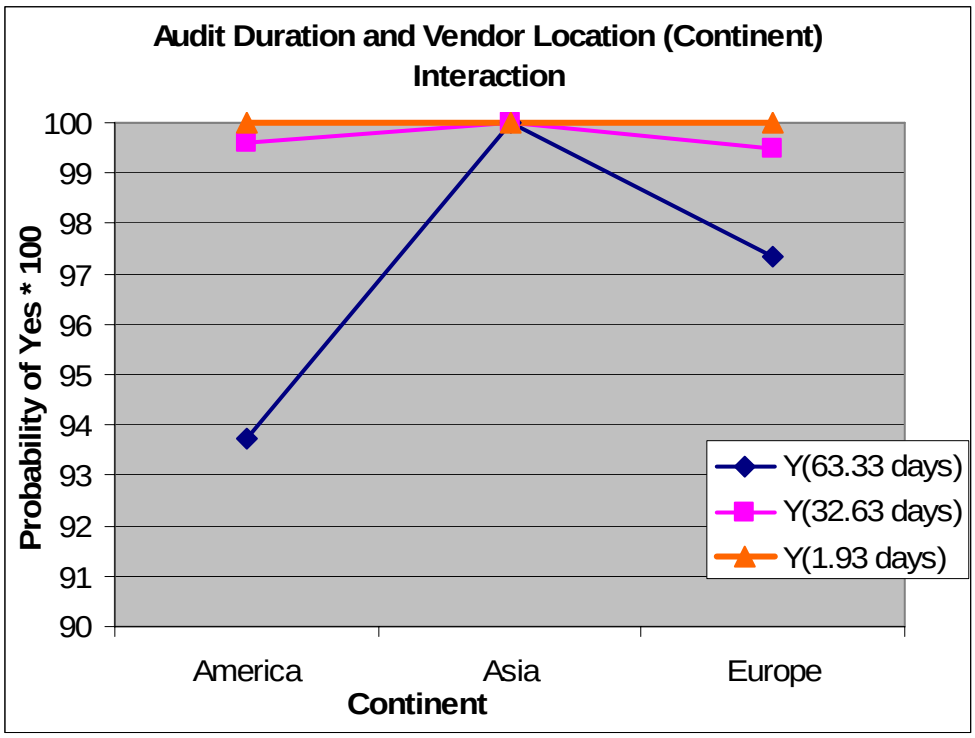


Figure VI displays the two way interaction of audit duration with continent ($p < 0.0001$). The response variable was measured at one level of the audit duration for various levels of continent. The audit duration mean from the historical data is 32.63 days with a standard deviation of 30.7days. Observing the chart we can conclude that there is a difference in the response rate at audit duration of about 63 days for

the American and European continents. For the American and European continents, this longer audit duration resulted in a lower response rate.

Figure VI. *Audit Duration and Continent Interaction*



Lastly, the model for technical audit is as follows:

Logit (response code) = β_1 Auditor Experience + $\beta_{2\,(1\text{ to }4)}$Audit Type(1 to 4) + β_3Audit Duration + $\beta_{4(1\text{ to }3)}$Continent (1 to 3) + $\beta_{5(1\text{ to }4)}$Auditor Experience * Audit Type (1 to 4) + β_6Auditor Experience * Audit Duration + $\beta_{7(1\text{ to }3)}$Auditor Experience * Continent (1 to 3) + $\beta_{8(1\text{ to }7)}$Auditor Experience * Process Measure (1 to 7) + $\beta_{9(1\text{ to }4)}$Audit Duration * Audit Type (1 to 4) + $\beta_{10(1\text{ to }3)}$Audit Duration * Continent (1 to 3) + β_0

In the above model, a categorical variable such as Audit Type is displayed as the variable name followed by a range within parenthesis. The range refers to the number of levels of the categorical variable. Thus, a variable Audit Type which has

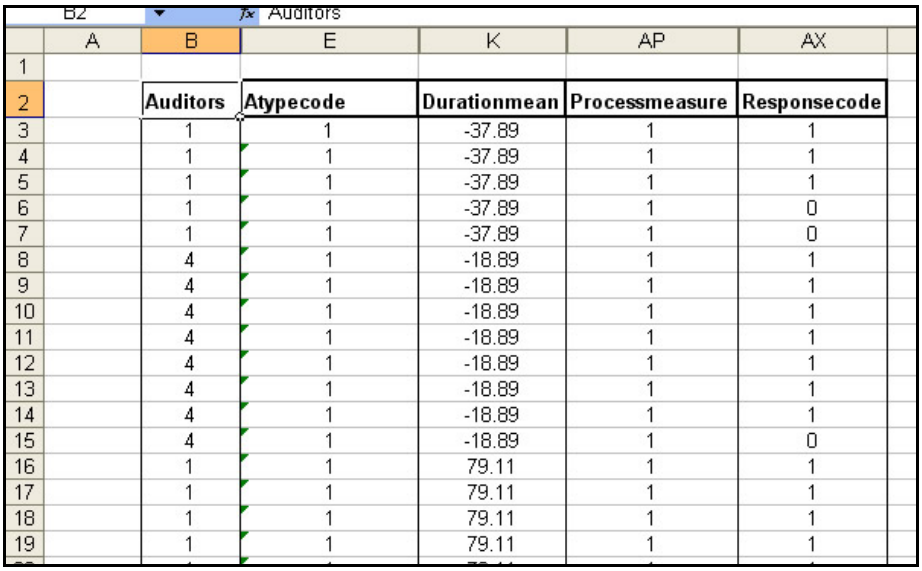
four levels is displayed as Audit Type (1 to 4) where 1 to 4 represents the four different audit type levels. β is used to represent the coefficients of the model. Each unique combination of the subscript of β with the numbers outside and within the parenthesis refers to the coefficients for a level of a variable in the model. However, in case of a continuous variable such as Auditor Experience since only one coefficient exists, the subscript of β does not include numbers in parenthesis.

As shown in the model equation above, β_1 refers to the coefficient for continuous variable Auditor Experience. For a categorical variable such as Audit type, $\beta_{2\,(1\text{ to }4)}$ refer to the four coefficients for the four levels of Audit Type variable in the model. β_0 refers to the intercept. Logit is the logistic probability unit. The different variables and the coefficients for the model are available in Appendix F under the Effect and Estimate columns respectively. The detailed model is available in Appendix G.

4.3 Internal Audit Model Generation

SAS program code was written to generate the model. To conduct logistic regression analysis, the data file (see Figure VII) and the SAS procedure statements in Figure VIII were used. Figure VII is a screenshot of the Excel data file containing the internal audit data. The details of the data are provided in the following pages as I explain the SAS output.

Figure VII. *Screenshot of Internal Audit Data File*



	A	B	E	K	AP	AX
1						
2		**Auditors**	**Atypecode**	**Durationmean**	**Processmeasure**	**Responsecode**
3		1	1	-37.89	1	1
4		1	1	-37.89	1	1
5		1	1	-37.89	1	1
6		1	1	-37.89	1	0
7		1	1	-37.89	1	0
8		4	1	-18.89	1	1
9		4	1	-18.89	1	1
10		4	1	-18.89	1	1
11		4	1	-18.89	1	1
12		4	1	-18.89	1	1
13		4	1	-18.89	1	1
14		4	1	-18.89	1	1
15		4	1	-18.89	1	0
16		1	1	79.11	1	1
17		1	1	79.11	1	1
18		1	1	79.11	1	1
19		1	1	79.11	1	1

The Class statement instructs the Proc Glimmix procedure to treat the variables Auditors and Processmeasure as categorical variables which are then dummy coded by SAS. Note that the variables Responsecode, Durationmean, Auditors and Processmeasure refer to Audit Response, Audit Duration, Auditors, and Process Measures respectively. The Model statement names the dependent variable and the fixed effects or the independent variables.

Figure VIII. *SAS Procedure used for Internal Audit Model Generation*

```
Proc Glimmix method = mspl;
Class Auditors Processmeasure;
Model Responsecode (event ='1' ) = Durationmean Processmeasure
 / s dist= binary;
Random intercept / sub = Auditors;
Title 'Auditors Internal Audits' ;
 Run;
```

The Distribution option determines how the Glimmix procedure models probabilities for the data. The Random statement specifies that the linear predictor contains an intercept term that randomly varies for different auditors. In other words, a random intercept is drawn separately and independently for each auditor in the study. The Model Information Table in Table XIII summarizes important information about the model and the estimation technique. Proc Glimmix recognizes the response variable Responsecode with a binary distribution. The estimation technique is MSPL.

There were fewer variables provided in the historical data for internal audit than for technical audit (See Appendix B). Further, the data contained large numbers of missing values for auditors and process measures. Since the variable Auditors was a level 2 variable, SAS ignored the entries with missing auditor data. Further, since the SAS approach adopted for developing the model involved assessing convergence, only two variables which converged – Audit Duration and Process Measures- could be used for analysis.

Table VIII. *Internal Audit Model Information*

Model Information	
Data Set	WORK.NIKHIL
Response Variable	Responsecode
Response Distribution	Binary
Link Function	Logit
Variance Function	Default
Variance Matrix Blocked By	Auditors
Estimation Technique	PL
Degrees of Freedom Method	Containment

In Table IX, the Class Level Information table lists the levels of the variables specified in the Class statement. Table X displays the number of observations read

and used in the analysis. There are two variables listed in the Class statement. The auditor variable has 3 levels, and the process measure variable has 6 levels. Table X shows that for this analysis, 2182 sample points were provided of which 1429 sample points were utilized for the model generation. Although the data included 6 auditors, sample points having missing data were excluded from the analysis. This explains the difference in the observations read and observations used and the missing values in the Class level information.

Table IX. *Internal Audit Class Level Information*

Class Level Information		
Class	**Levels**	**Values**
Auditors	3	1 4 7
Processmeasure	6	1 2 3 4 5 6

Table X. *Number of Observations*

Number of Observations Read	2182
Number of Observations Used	1429

Table XI shows information about the fit of the GLM. With a ratio of 0.97, the model appears to exhibit a good fit of the data.

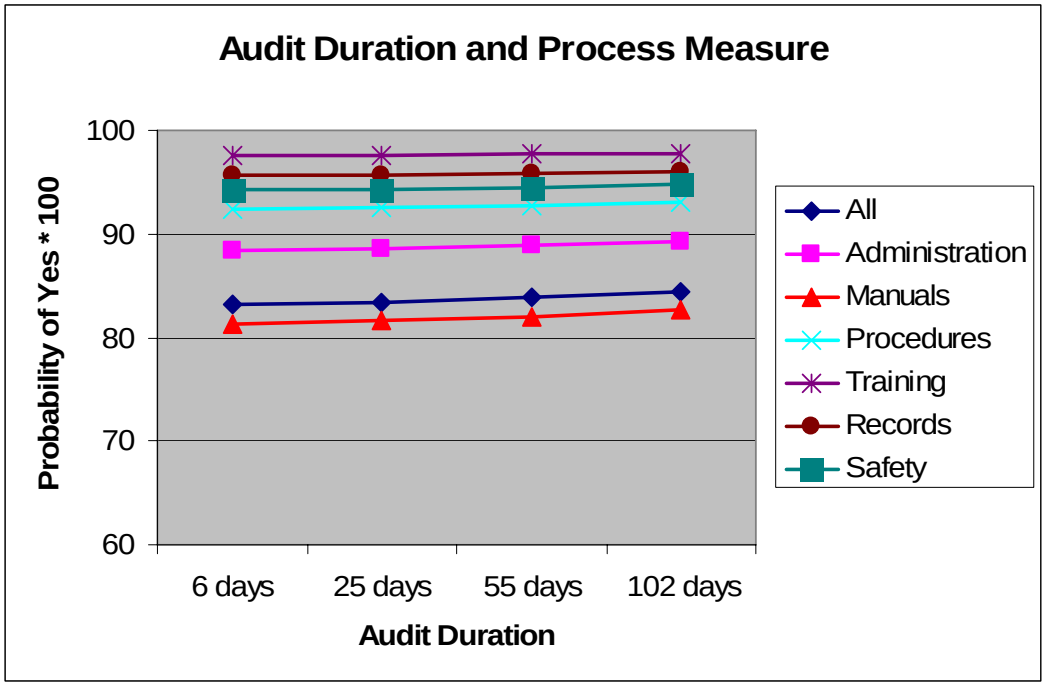
Table XI. *Fit Statistics*

Fit Statistics	
-2 Log Pseudo-Likelihood	7338.90
Generalized Chi-Square	1383.69
Gener. Chi-Square / DF	0.97

The Type III Tests of Fixed Effect displays significance tests for the two fixed effects in the model (see Appendix H). The Process Measure main effect was found to be significant ($p < 0.05$). In Appendix I, the parameter estimates table

displays the maximum likelihood estimates, standard errors, and t tests for the hypothesis that the estimate is zero. The estimates in this table form the coefficients for the variables of the corresponding model variables. The *p* in the column Pr>|t| shows if the difference in the levels of the categorical variables are significant. Only the process measure line displayed as Processmeasure2 is significantly different from process measure displayed as Processmeasure6 ($p = 0.01$) where Processmeasure2 refers to Manuals and Processmeasure6 refers to Safety. Figure IX presents the model response rate graphically for various cases. In general, for different audit durations the Manuals process measure gives the lowest response rate.

Figure IX. *Process Measure and Audit Duration*



Lastly, the model for internal audit is: Logit (Response code) = $\beta_{1(1to6)}$ Process Measure (1 to 6) + $\beta_{0.}$

In the above model, the categorical variable Process Measure is displayed as the variable name followed by a range of 1 to 6 within parenthesis. The range refers

to the number of levels of the Process Measure. β is used to represent the coefficients of the model. Each unique combination of the subscript of β with the numbers outside and within the parenthesis refers to the coefficients for a level of a variable in the model. As shown in the model equation above, $\beta_{1\ (1\ to\ 6)}$ refer to the six coefficients for the six levels of Process Measure variable in the model. β_0 refers to the intercept. Logit is the logistic probability unit. The coefficients of the variables for the model are available in Appendix I under the Estimate column. The detailed model is available in Appendix J.

4.4 Surveillance Model Generation

To conduct logistic regression analysis, the data file (see Figure X) and the SAS procedure statements in Figure XI were used. Figure X is a screenshot of the Excel data file containing the surveillance data. The details of the data are provided in the following pages as I explain the SAS output.

Figure X. *Screenshot of Surveillance Data File*

	A	B	C	O	P	Q	R	S	T	U
1	PM	Vendcode	Contcode	Aircraft	Aircraftmfgcode	Aircraftmodelcode	Aircraftagemean	Responsecode		
2	1	11	1	166	1	1	15.923	1		
3	1	11	1	166	1	1	15.923	1		
4	1	11	1	166	1	1	15.923	1		
5	1	11	1	166	1	1	15.923	1		
6	1	11	1	166	1	1	15.923	1		
7	1	11	1	166	1	1	15.923	1		
8	1	11	1	166	1	1	15.923	1		
9	1	11	1	166	1	1	15.923	1		
10	1	11	1	166	1	1	15.923	1		
11	1	11	1	166	1	1	15.923	1		
12	1	11	1	166	1	1	15.923	1		
13	1	11	1	166	1	1	15.923	1		
14	1	11	1	166	1	1	15.923	1		
15	1	11	1	166	1	1	15.923	1		
16	1	11	1	166	1	1	15.923	1		
17	1	11	1	166	1	1	15.923	1		
18	1	11	1	166	1	1	15.923	1		
19	1	11	1	166	1	1	15.923	1		
20	1	11	1	166	1	1	15.923	1		
21	1	11	1	166	1	1	15.923	1		
22	1	11	1	166	1	1	15.923	1		
23	1	11	1	166	1	1	15.923	1		
24	1	11	1	166	1	1	15.923	1		
25	1	11	1	166	1	1	15.923	1		
26	1	11	1	166	1	1	15.923	1		
27	1	11	1	166	1	1	15.923	1		
28	1	11	1	166	1	1	15.923	1		
29	1	11	1	166	1	1	15.923	1		
30	1	11	1	166	1	1	15.923	1		
31	1	11	1	166	1	1	15.923	1		
32	1	11	1	166	1	1	15.923	1		

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As seen in Figure XI, the Proc Glimmix statement invokes a SAS procedure. The Class statement instructs the procedure to treat the variables Aircraftmodelcode, PM, Vendcode and Contcode as categorical variables which are then dummy-coded by SAS. Note that the variables Responsecode, Vendcode, Aircraftmodelcode, PM and Contcode refer to Surveillance Response, Vendor, Aircraft Model, Process Measure and Continent respectively. The Model statement names the dependent variable and the fixed effects or the independent variables.

Figure XI. *SAS Procedure used for Surveillance Model Generation*

```
Proc Glimmix method = mspl;
Class PM Vendcode Contcode Aircraftmodelcode;
Model Responsecode (event ='1' ) = Contcode Aircraftmodelcode
Aircraftagemean PM PM*Contcode PM*Aircraftagemean
Contcode*Aircraftagemean / s dist= binary;
Title 'Surveillance' ;
Random intercept / sub = Vendcode;
Run;
```

The Distribution option, displayed as "dist" in Figure XI, determines how the Glimmix procedure models probabilities for the data. The Random statement specifies that the linear predictor contains an intercept term that randomly varies at the level of vendor effect. In other words, a random intercept is drawn separately and independently for each vendor in the study. The output information generated from the Glimmix procedure is explained in the subsequent pages. The Model Information Table in Table XII summarizes important information about the model

and the estimation technique. Proc Glimmix recognizes the response variable Responsecode with a binary distribution. The estimation technique is maximum subject pseudo-likelihood (MSPL).

Table XII. *Surveillance Model Information*

Model Information	
Data Set	WORK.NIKHIL
Response Variable	Responsecode
Response Distribution	Binary
Link Function	Logit
Variance Function	Default
Variance Matrix Blocked By	Vendcode
Estimation Technique	PL
Degrees of Freedom Method	Containment

In Table XIII, the Class Level Information table lists the levels of the variables specified in the Class statement. The Number of Observations table (See Table XIV) displays the number of observations read and used in the analysis. There is no difference in the observations read and observations used as all the data was utilized for the analysis. There are four variables listed in the Class statement. Table XIV shows that for this analysis, 82166 sample points were provided, all of which were utilized for the model generation.

Table XIII. *Surveillance Class Level Information*

Class Level Information		
Class	**Levels**	**Values**
PM	6	1 2 3 4 5 6
Vendcode	14	1 2 3 4 5 6 7 8 9 10 11 12 13 14
Contcode	3	1 2 3
Aircraftmodelcode	8	1 2 3 4 5 6 7 8

Table XIV. *Surveillance Model Number of Observations*

Number of Observations Read	82166
Number of Observations Used	82166

Table XV shows information about the fit of the generalized linear models (GLM). The log likelihood reported in the table is the residual log likelihood for an approximated model and represents the fit of the surveillance model in representing the data. The generalized chi-square statistic is analogous to the residual sum of squares in the final model and the ratio with its degrees of freedom is a measure of variability of the observation about the mean model. Typically, the ratio between the Generalized Chi-Square and its degrees of freedom should equal one in GLMs. Values approaching two or more are indicative of the model's inability to represent the variability in the data. With a ratio of 1.03, the data appears to exhibit less dispersion than expected.

Table XV. Surveillance *Fit Statistics*

Fit Statistics	
-2 Log Pseudo-Likelihood	466009.2
Generalized Chi-Square	84231.74
Gener. Chi-Square / DF	1.03

The Type III Tests of Fixed Effect displays significance tests for the four fixed effects and three two way interaction effects in the model (see Appendix K). Three of the four main effects, aircraft model, aircraft age and process measure were found to be significant (p <0.05). The fourth main effect of continent reflecting vendor location was not found to be significant (p = 0.066). However, the two way interactions of process measure and location of the vendor (PM*Continent), aircraft

age and process measure (Aircraft age * PM), and aircraft age and vendor location (Aircraft age * Continent) are significant (p <0.05). Further, the SAS approach adopted for developing the model involved assessing convergence and since the three way and four way interactions did not converge, they were not included in the model. In Appendix L, the parameter estimates table displays the maximum likelihood estimates, standard errors, and t tests for the hypothesis that the estimate is zero (i.e. the predictor variable has no effect on the response rate). The estimates in this table form the coefficients of the corresponding variables in the model. The p in the column Pr>|t| shows if the difference in the levels of a categorical variable to its reference level are significant. For example, the aircraft model 1 (Boeing 727) displayed as aircraftmodelcode1 is significantly different from aircraft model 8 (Cessna 208) displayed as aircraftmodelcode8 (p = 0.0203), as seen in Appendix L.

The significant interaction effects were analyzed. To evaluate the two way interaction of process measure with continent, the response variable was measured at one level of the process measure for various levels of continent. The process measure levels are In process, Verification, Final Walkaround Documentation, Facility and Procedures Manual Violation. Continent levels are America, Asia and Europe respectively. The interaction was assessed for each of the eight fleet types. In general the interaction for all the aircraft and process measures was similar for all fleet types. Figure XII displays the two way interaction of process measure with continent for vendor location. Observing the chart we can conclude, there is a difference in the rejection rate for the Asian continent vendors compared to the American or European continent vendors for the non-technical process measures of Documentation Surveillance, Facility Surveillance and Procedures Manual Violation

Surveillance. The rejection rate for vendors in the American continent was higher than that in the European continent for Final Walkaround process measure. Across all continents, the rejection rate is high for the non-technical process measures of Facility Surveillance and Procedures and Manual Violation. The rejection rate for technical process measure of Final Walkaround is higher than that observed for the other technical process measures of In Process and Verification on the American continent.

Figure XII. *Process Measure and Vendor Location (Continent) Interaction Effect*

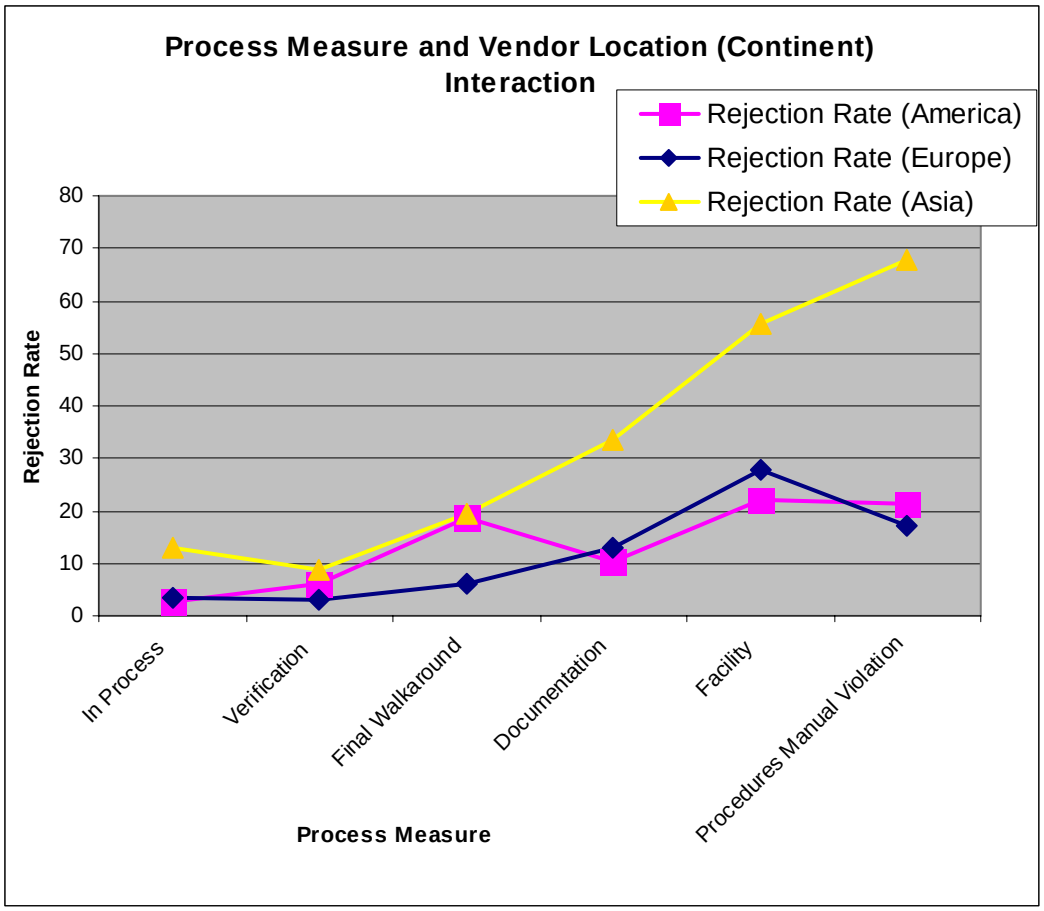


Figure XIII shows the two way interaction of aircraft type and continent for vendor location ($p < 0.0001$). Figure XIV shows the two way interaction of aircraft type and vendors from European continent. The response variable was measured at

each of the three levels of the aircraft age for various levels of process measure. The aircraft age mean from the historical data is 24.07 years with a standard deviation of 8.2 years. The interaction between aircraft age and process measures was similar for all the aircraft. Observing the charts we can conclude that for a change in aircraft age, there is a difference in the rejection rate for the technical process measure of Final Walkaround for the American and Asian vendors unlike the two other technical process measures of In Process and Verification. In general, for all the process measures the older aircraft had a higher rejection rate except for Documentation process measure on the European continent. The rejection rate for the non-technical process measures of Facility and Procedures Manual Violation were higher than the other process measures especially on the Asian continent.

Figure XIII. *Aircraft Age and Process Measure Interaction Effect*

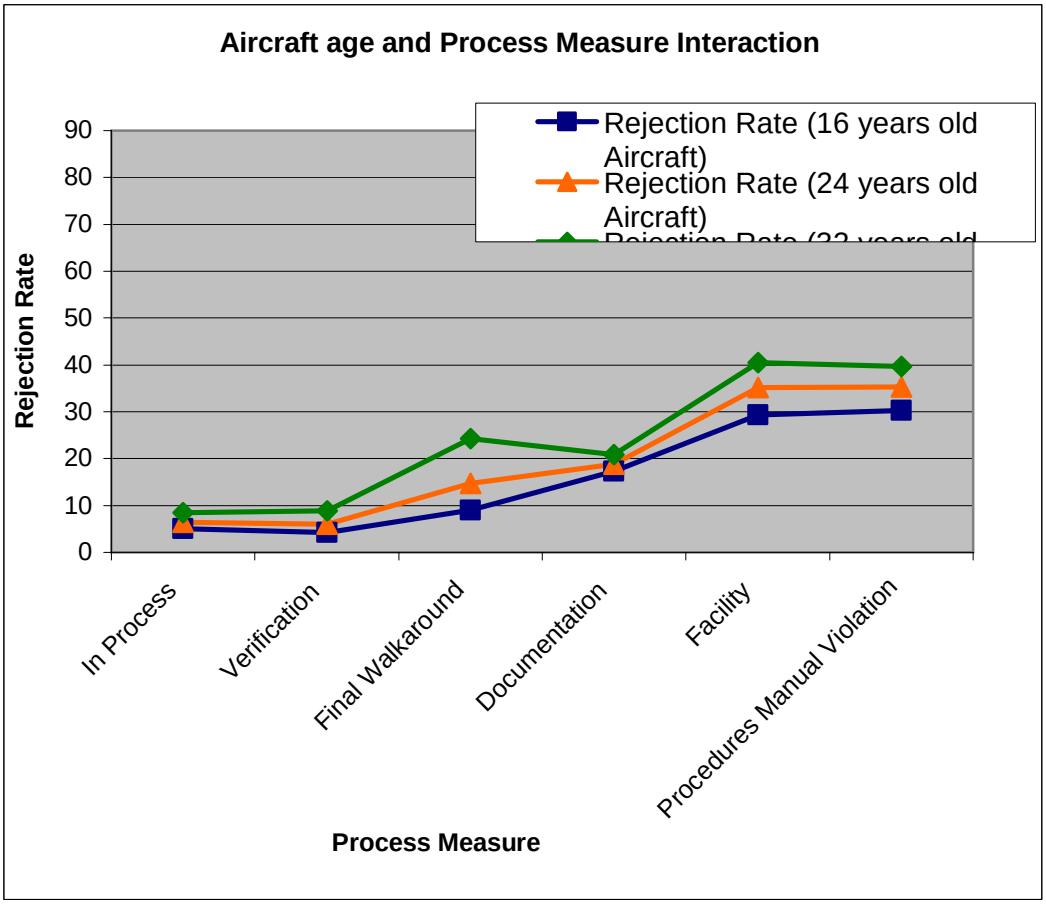


Figure XIV. *Aircraft Age and Process Measure Interaction Effect- Europe*

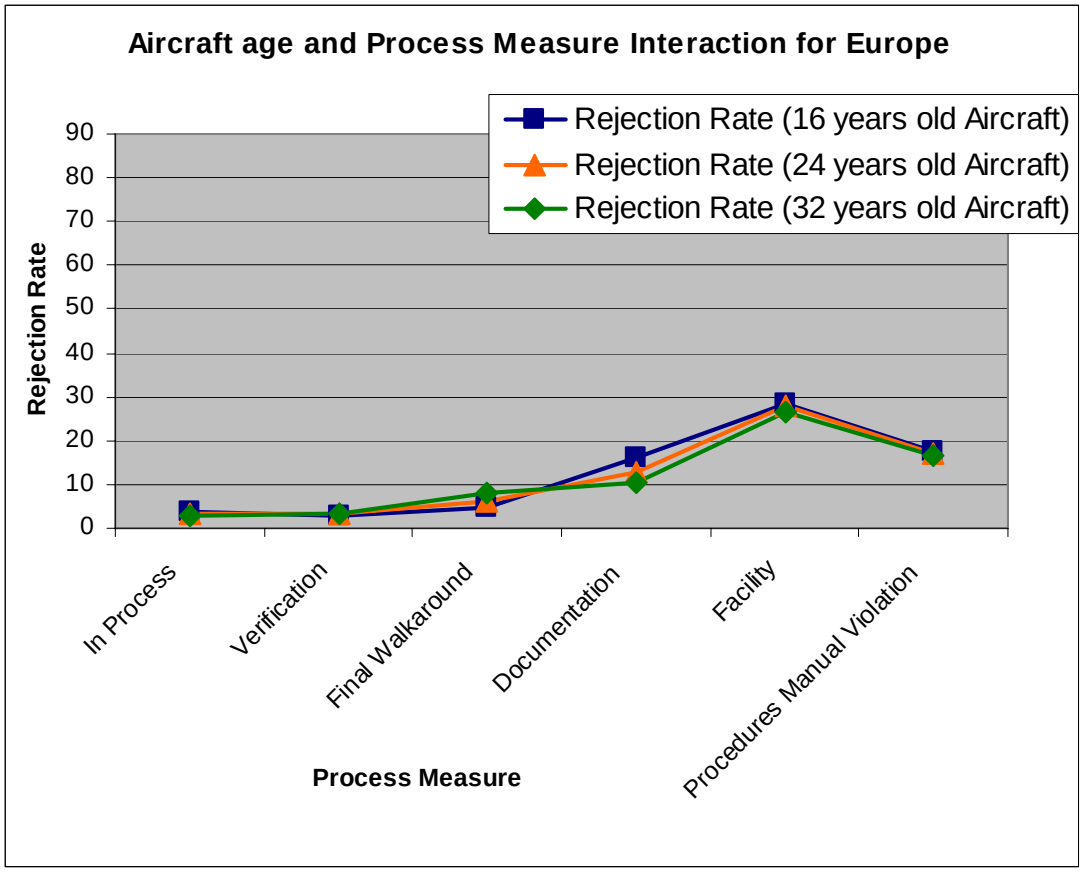
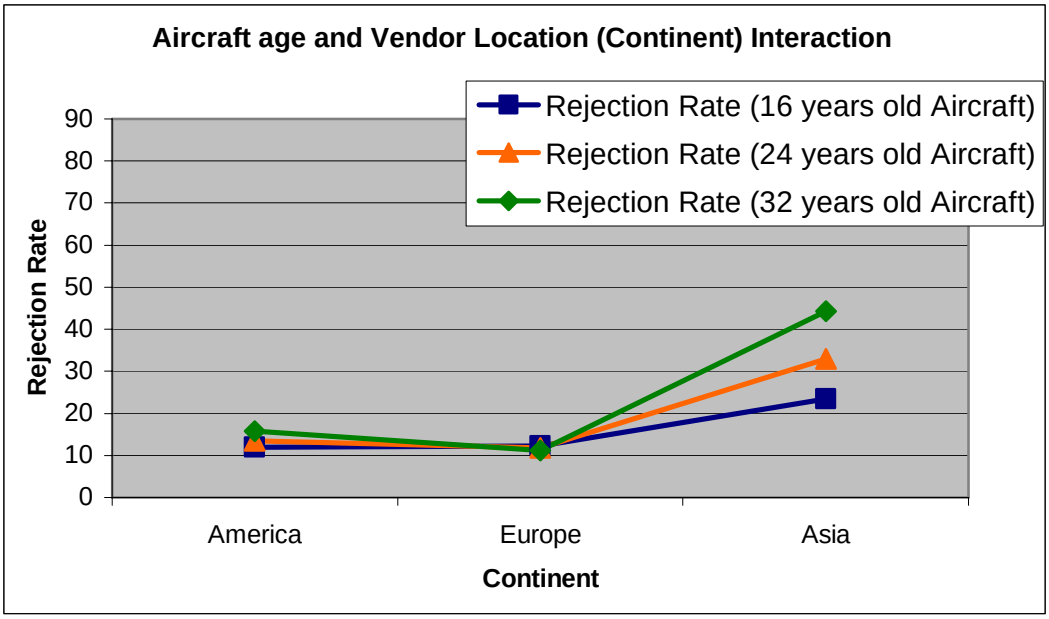


Figure XV displays the two way interaction of aircraft age with continent for vendor location ($p < 0.0001$). The response variable was measured at each of the three levels of the aircraft age for various levels of continent. As mentioned earlier, the aircraft age mean from the historical data is 24.07 years with a standard deviation of 8.2 years. The interaction for all the aircraft at each process measure was similar. Observing the charts we can conclude that there is a difference in the rejection rate for the Asian continent. In general, for all three continents the older aircraft had a higher rejection rate except for Documentation Surveillance process measure on the European continent.

Figure XV. *Aircraft age and Continent Interaction Effect*



Lastly, the model for surveillance is as follows:

Logit (response code) = β_1 Aircraft Age + $\beta_{2\,(1\text{ to }8)}$ Aircraft Type (1 to 8) + $\beta_{3(1\text{ to }6)}$ Process Measure (1 to 6) + $\beta_{4(1\text{ to }3)}$Continent (1 to 3) + $\beta_{5(1\text{ to }18)}$ Process Measure (1 to 6) * Continent (1 to 3) + $\beta_{6(1\text{ to }6)}$ Aircraft Age * Process Measure (1 to 6) + $\beta_{7\,(1\text{ to }3)}$ Aircraft Age* Continent (1 to 3) + β_0

In the above model, a categorical variable such as Aircraft Type is displayed as the variable name followed by a range within parenthesis. The range refers to the number of levels of the categorical variable. Thus, a variable Aircraft Type which has eight levels is displayed as Aircraft Type (1 to 8) where 1 to 8 represents the eight different aircraft type levels. β is used to represent the coefficients of the model. Each unique combination of the subscript of β with the numbers outside and within the parenthesis refers to the coefficients for a level of a variable in the model.

However, in case of a continuous variable such as Aircraft Age since only one coefficient exists, the subscript of β does not include numbers in parenthesis.

As shown in the model equation above, β_1 refers to the coefficient for continuous variable Aircraft Age. For a categorical variable such as Aircraft type, $\beta_{2\,(1\text{ to }8)}$ refer to the eight coefficients for the eight levels of Aircraft Type variable in the model. β_0 refers to the intercept. Logit is the logistic probability unit. The coefficients of the variables for the model are available under the Estimate column in Appendix L. The detailed model is available in Appendix M.

4.5 Discussion of Model Results

The modeling results are promising for Technical Audit and Surveillance. The results obtained for Internal Audit are insufficient. This can be attributed to the insufficiency of data for the variables. Due to confidentiality reasons, the data on variables such as auditor characteristics (e.g., auditor age and experience) and department characteristics (e.g., department size and department location) were not provided. In other cases, inaccessibility of data on variables proved to be a difficulty. For example, vendor characteristics, such as number of service orders and period of vendor service existed in disparate systems from which data retrieval was virtually impossible. Since logistic regression models thrive on variability in group characteristics, lack of variables for a group level and inadequate data limit the accuracy of the model.

The Technical Audit model showed that the two way interactions of auditor experience and location of the vendor, audit duration and audit type, and audit duration and vendor location are significant (p <0.05). Observing the interactions of auditor experience and location of the vendor, and audit duration and vendor

location, the vendor performance of the Asian continent seemed to be virtually perfect. This result should be further evaluated to understand the characteristics that cause this. For example, it could be that the auditors who conducted the audits on Asia were not as objective in conducting their audits as were the auditors on other continents. Conversely, it may also be that the Asian vendors pay more attention to their business process and its associated regulations to achieve outstanding response rates of 100%. The data on continents could be further broken down to individual countries to provide more specific discussion. Observing the interactions of the audit duration and audit type, and audit duration and vendor location, it can be said that the response rate deteriorates if the audit duration increases, independent of the audit type and continent, except for the Asian continent. This is particularly prominent in Suppliers audits and on the American continent. This result may be especially useful for managers, who would now have a reason to believe that audit durations should be short and swift especially if they are Supplier audits on the American continent.

The Surveillance model showed that aircraft type, aircraft age and process measure produced significant main effects. The two way interactions of process measure and location of the vendor, aircraft age and process measure, and aircraft age and vendor location are also significant ($p < 0.05$). Considering the Surveillance model interaction results of vendor location and process measure, one can speculate that the rejection rate for vendors on the American continent was higher than that on the European continent for Final Walkaround process measure due to vendor characteristics. In my interaction with the surveillance personnel, during my historical data collection trip, the representatives expressed their dissatisfaction over

inconsistent maintenance performance by American vendors in comparison to their European counterparts. The high rejection rate for vendors located on the Asian continent is a direct contrast to the results obtained in the Technical Audits analysis. The performance of Asian vendors varies sharply between technical and non-technical process measures where the latter produces higher rejection rates.

In general, the high rejection rate for the non-technical process measures of Facility Surveillance and Procedures and Manual Violation could be attributed to the representatives' drive to meet the managers' weekly goals for process measures at the end of the week. Such chunking of non-technical surveillance activities could be the cause for higher rejection rate. Final Walkaround is a surveillance activity which involves inspection of the aircraft before it is signed back in to the airline fleet. This process measure activity leads to typical findings such as removal of tags, and safety lines. The high rejection rate for the technical process measure of Final Walkaround indicates the poor ability of the vendor to complete maintenance tasks as stated in the manual. As an aircraft grows old, the maintenance activities conducted on the aircraft increase. This may explain the general trend of higher rejection rate with older aircraft. However, it will be worthwhile understanding from the surveillance personnel the cause for the reverse trend shown for the Documentation Surveillance process measure on the European continent.

Chapter VII provides more discussion and continues with input from auditors, representatives and managers and their reaction to the results presented by the models.

CHAPTER V: INTERFACE DESIGN AND EVALUATION

Any system designed for people to use should be easy to learn, useful, containing functions they really need in their work, and easy to use. To design WebSAT for auditors and surveillance representatives, it was paramount to understand their current work processes. The current work practices at the airline, participating in this research, for auditing are manual. The technical auditors use hard copy checklists for conducting audits. The internal auditors create checklists on Excel spread sheets. A checklist contains questions assessing the quality and regulation compliance of the various processes in a vendor/department. Each question in a checklist includes forced responses of either "Yes" or "No". These forced responses are documented on the checklists by marking the appropriate response and entering an audit finding for the associated question on the checklist. The surveillance department has an on-line system that quality assurance representatives use to document maintenance findings. These findings are entered as an "Accept" or a "Reject" of the maintenance activity.

The current research involved development of models to facilitate prediction of vendor/ department performance and planning for future audits and surveillance. At the airline, participating in this research, there was no tool in place to conduct such analysis. The quality assurance representatives (QAR) and managers spend a lot of time gathering data, leaving little or no time for subsequent analysis. Further, the unavailability of a model prevents them from understanding factors affecting vendor performance. Following its development, the model will be available in WebSAT in the form of a prediction and planning tool.

5.1 Identify User Needs

WebSAT caters to the needs of stakeholders at two levels for associated work functions in the quality assurance department at participating airline. At the first level, auditors and surveillance representatives are able to analyze and predict the performance of vendors/ departments with minimal effort and time. At the second level, managers can use the model to plan for future audits and allocate resources accordingly. Stakeholder needs were developed based on the results of interviews, focus group sessions, and observing the stakeholders performing their tasks. The user needs involved in analyzing vendor/department performance are shown in Table XVI. The needs expressed are general in nature, and were a good starting point to develop attributes of the prediction and planning tool.

Table XVI. *Need Statements*

Need #	**Tool**	**Need Statement**
1	WebSAT	identifies the source of risk factors to the aircraft.
2	WebSAT	presents information which will benefit the QAR.
3	WebSAT	indicates the potential risk to the aircraft because of technical audit findings.
4	WebSAT	recommends information to assist in future technical audits.
5	WebSAT	allows the auditor to view discrepancies which impact the aircraft.
6	WebSAT	has the ability to indicate potentially problematic areas in an internal audit.
7	WebSAT	has the ability to report critical findings for internal audits at a managerial level.

Following identification of user needs, it is important to assess the relative importance of different needs (Ulrich and Eppinger, 2004). I combined the importance ratings of the managers of the quality assurance department to develop a needs rating list (Appendix N).

5.2 Establish Target Specifications

Product development teams establish target specifications, which represent precise, measurable details about what the product has to do (Ulrich and Eppinger, 2004). Table XVII shows the list of target specifications developed for the prediction and planning tools. The values in the columns "WebSAT without the model" and "WebSAT with the model" will allow me to understand the success of the prediction planning tool. This table will be revisited in Chapter VI with values provided in the above two columns.

Table XVII. *Target Specifications*

Metric #	Need Numbers	Metric	Units	WebSAT without the model	WebSAT with the model
1	2, 4, 6	Time taken to generate useful information for future maintenance and audits.	minutes		
2	2, 3, 6, 7	Time taken to analyze vendor/ department performance	minutes		
3	1, 3, 5, 6	Time to identify risk factors.	minutes		
4	2, 4, 6	Ability to generate useful information for future maintenance and audits.	Subj.		

5.3 Interface Design and Development

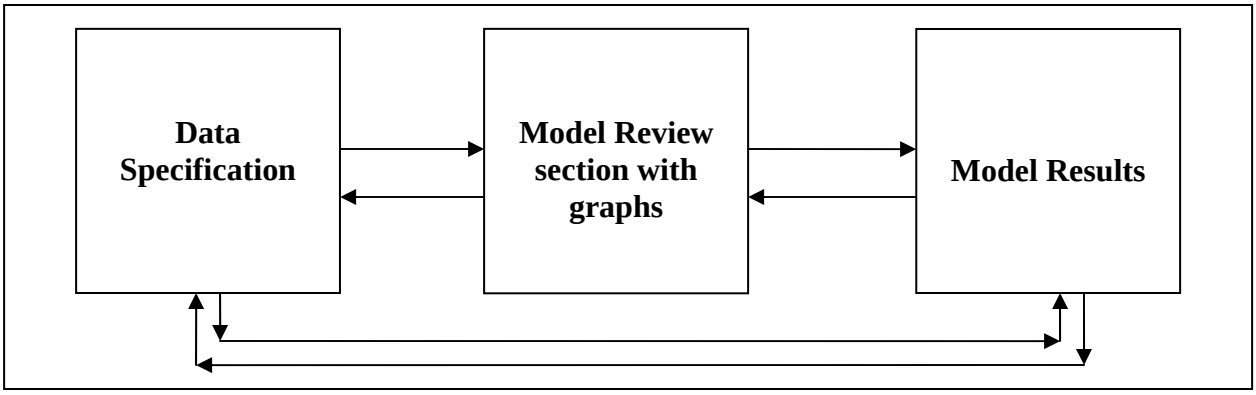
Paper prototypes applying the model for vendor/department performance analysis were developed. The methodologies of user-centered design (Ulrich and Eppinger, 2004) and usability testing were adopted for this purpose. The model was implemented in WebSAT. Depending on the type of user, the model can be accessed from two of the three links, Audit Impact, Audit Allocation and Surveillance Planning, in the "Report" tab of the tool. The Audit Impact link is available only in

the auditing modules of technical and internal audits and is visible only when auditors log into WebSAT. The Audit Allocation link is only visible to the managers who log into technical and internal audits modules of WebSAT. The Surveillance Planning link is visible to the surveillance representatives and managers who log into the surveillance module of WebSAT. Using the Audit Impact, Audit Allocation and Surveillance Planning links gives the auditors, surveillance representatives and managers access to prediction and planning tools to identify and understand the effect of different predictor variables on vendor/ department performance and to plan for future surveillance and audits. The paper prototypes were implemented using ASP.NET in the WebSAT prototype. Thus, the prediction and planning tools represent added features in WebSAT.

5.4 Screen Designs (Iteration 1)

This section discusses screens presented on clicking the Audit Impact, Audit Allocation and Surveillance Planning links in the WebSAT global navigation "Reports" tab. In the "Reports" tab, the technical and internal audit modules displayed the Audit Impact and Audit Allocation links while the Surveillance Planning link was displayed in the surveillance module. In general, the screens in the Audit Impact, Audit Allocation and Surveillance Planning sections followed a similar pattern of (a) data specification where the user entered data specifying the values of the model variables; (b) model review where the user reviewed the model and the different graphical interactions; and (c) model results where the user viewed the model's predicted rejection or response rate (See Figure XVI).

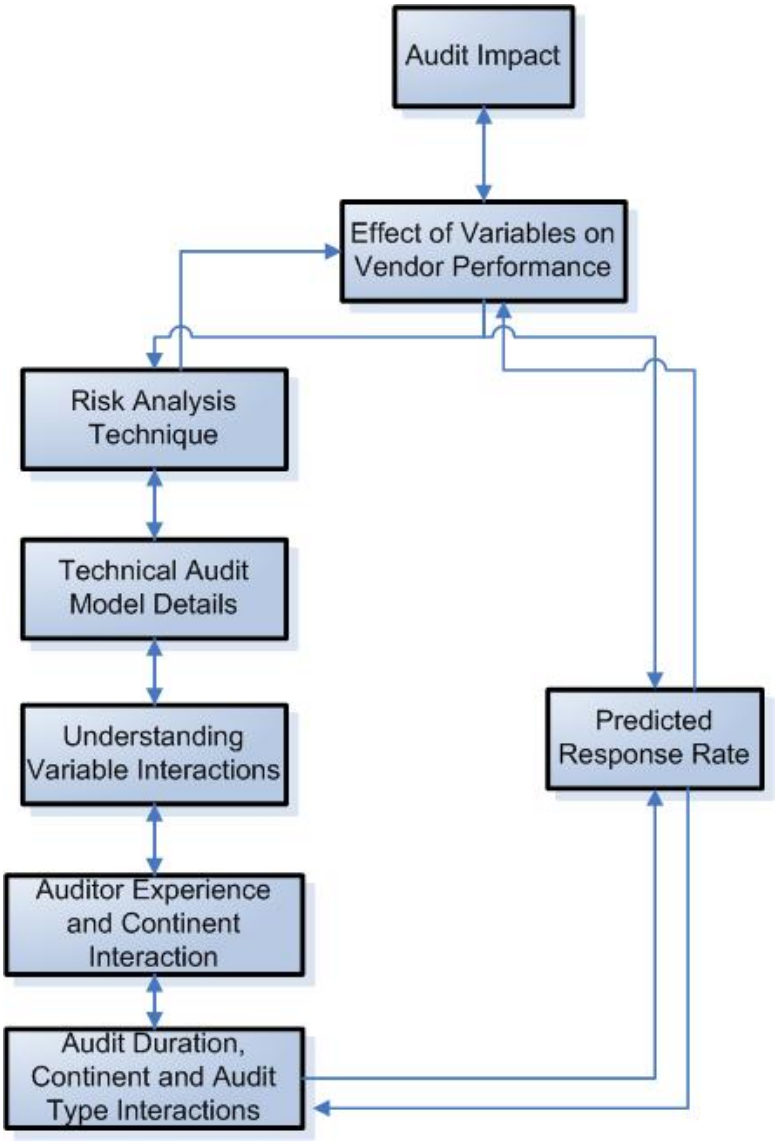
Figure XVI. *Prediction and Planning Tool Pattern*



5.4.1 Technical Audit Module Screens- Audit Impact

The product map for the Technical Audit module's Audit Impact screens is shown in Figure XVII. The product map displays the navigation across the Audit Impact screens.

Figure XVII. *Audit Impact Product Map*



The details on the screens in the Audit Impact section are presented in the figures below. When the auditor clicks on the Audit Impact link on the global navigation "Reports" tab of the Technical Audit module, the Audit Impact page is revealed. The auditor can perform two tasks in this page, as shown in Figure XVIII:

1. Select choices from the drop down menus, enter information in the text box and click on the Calculate Predicted Response Rate button to begin using the Audit Impact tool.

2. Click on the What is this page about? link to understand the purpose of the Audit Impact tool (See Figure XIX).

Figure XVIII. *Audit Impact Screen*

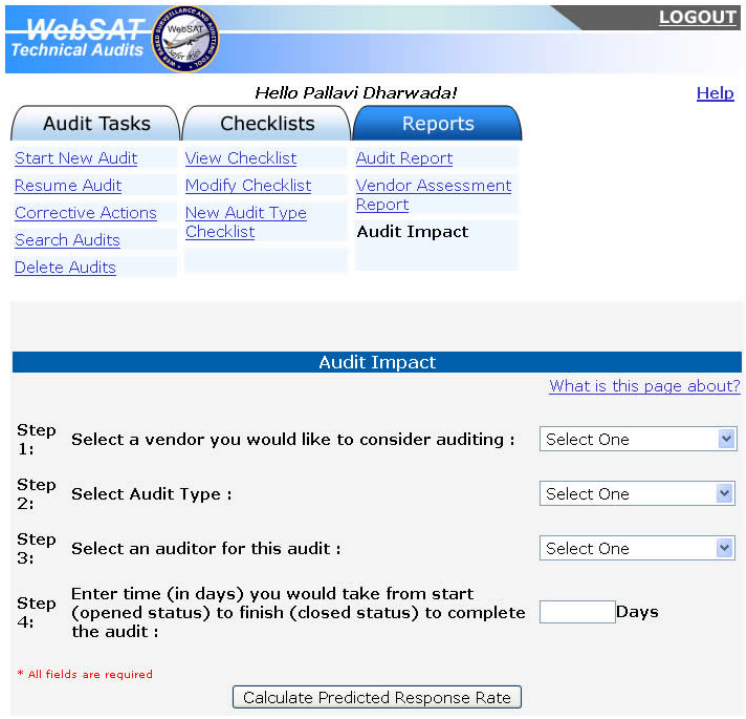
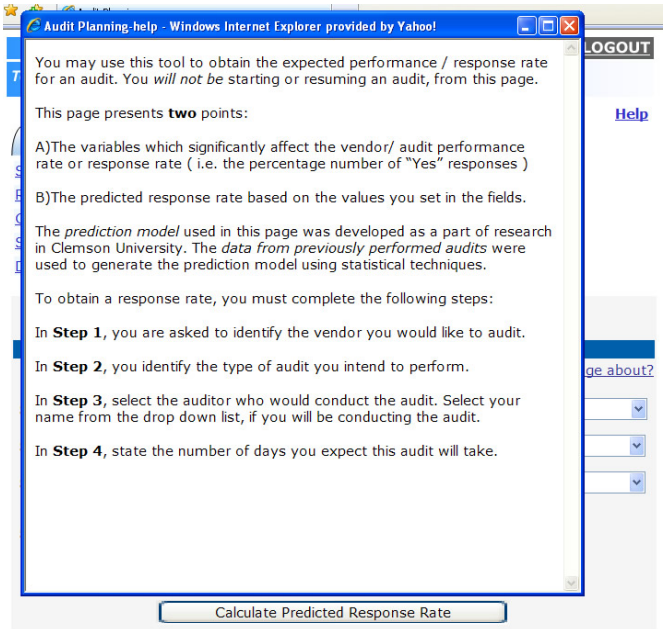
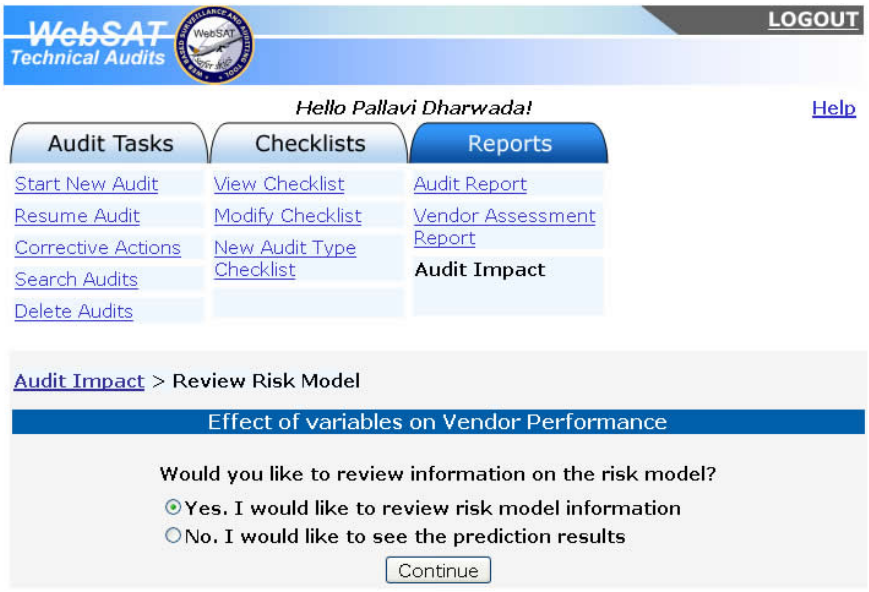


Figure XIX. *What is this page about?*



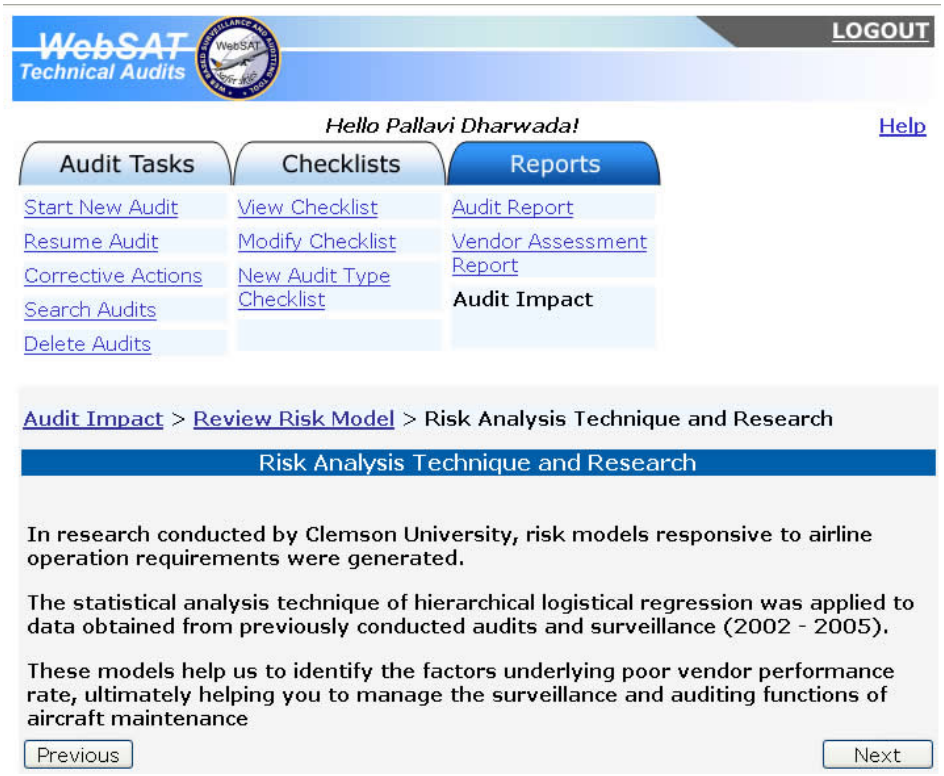
The Effect of Variables on Vendor Performance page can be reached from the Audit Impact page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page gives the auditor the option to review the model information or view the prediction results, as shown in Figure XX. The first radio button choice of "Yes. I would like to review risk model information" is set as the default option. The auditor can also choose the other option and click on the Continue button to proceed to the prediction results.

Figure XX. *Effect of Variables on Vendor Performance*



The Risk Analysis Technique and Research page can be reached from the Effect of Variables on Vendor Performance page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page gives the auditor a review of the research involved in the development of the model, as shown in Figure XXI. The auditor can click on the Previous button to return to the Effect of Variables on Vendor Performance page. The auditor can also click on the Next button and proceed to the next page in the model review section.

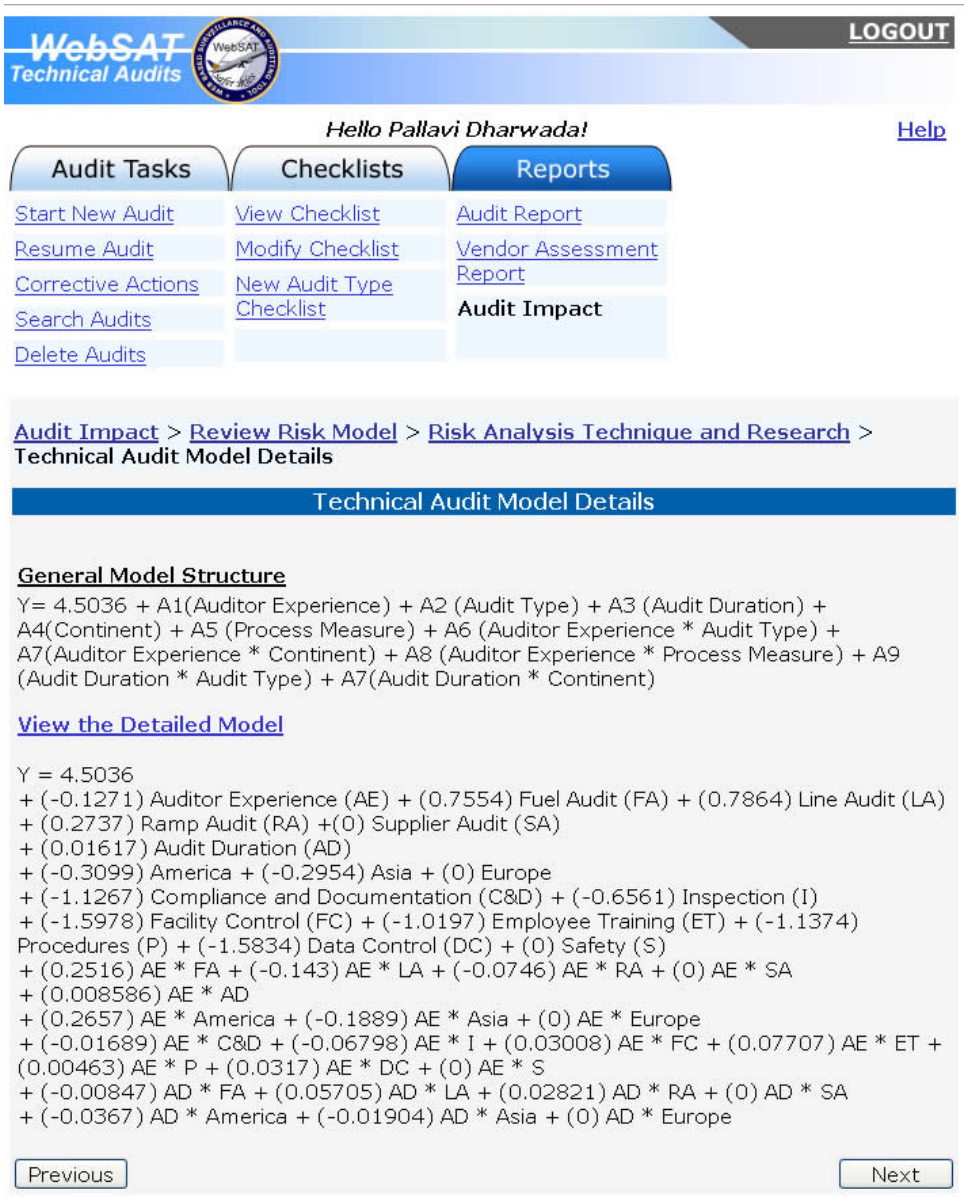
Figure XXI. *Risk Analysis Technique and Research*



The Technical Audit Model Details page can be reached from the Risk Analysis Technique and Research page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to view the general structure of the model, as shown in Figure XXII (a). The auditor can also click on the View the Detailed Model link to see the detailed model which includes the values of the coefficients of the model variables, as shown in Figure XXII (b). The auditor can click on the Previous button to return to the Risk Analysis Technique and Research page. The auditor can also click on the Next button and proceed to the next page in the model review section.

Figure XXII (a). *Technical Audit Model Details - General Model Structure*

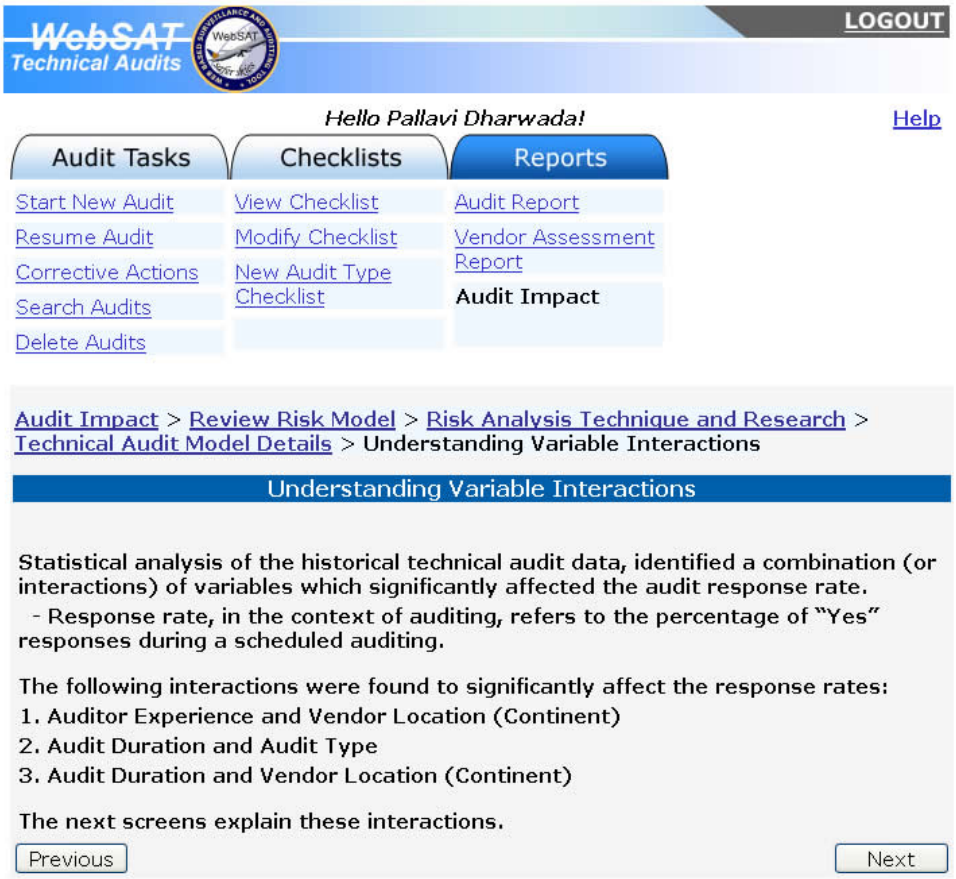
Figure XXII (b). *Technical Audit Model Details – Detailed Model*



The Understanding Variable Interactions page can be reached from the Technical Audit Model Details page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to understand the predictor variables and their interactions that significantly affect the response rate, as shown in Figure XXIII. The auditor can click on the Previous

button to return to the Technical Audit Model Details page. The auditor can also click on the Next button and proceed to the next page in the model review section.

Figure XXIII. *Understanding Variable Interactions*

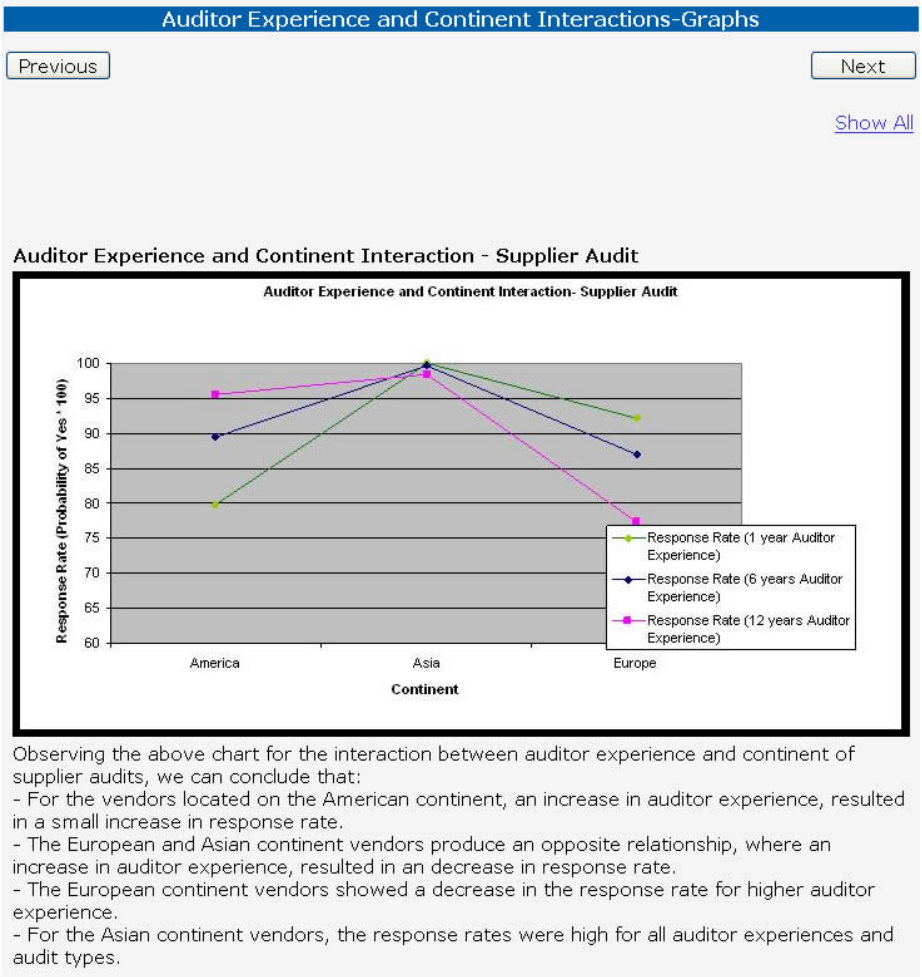


The Auditor Experience and Continent Interactions page can be reached from the Understanding Variable Interactions page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to understand the effect of the interaction between the auditor experience and vendor location on the response rate, as shown in Figure XXIV. The graphical image displayed is contextual albeit static in nature. The tool displays the appropriate image based on the selections made in the Audit Impact page. Since the auditor chose Supplier as the audit type in the Audit Impact page, the tool displays

the interaction between the auditor experience and vendor location for a Supplier audit type (as shown in Figure XXIV).

The auditor can click on the Show All link, to view the effect of the interaction between the auditor experience and vendor location for all audit types. The auditor can click on the Previous button to return to the Understanding Variable Interactions page. The auditor can also click on the Next button and proceed to the next page in the model review section.

Figure XXIV. *Auditor Experience and Continent Interactions*

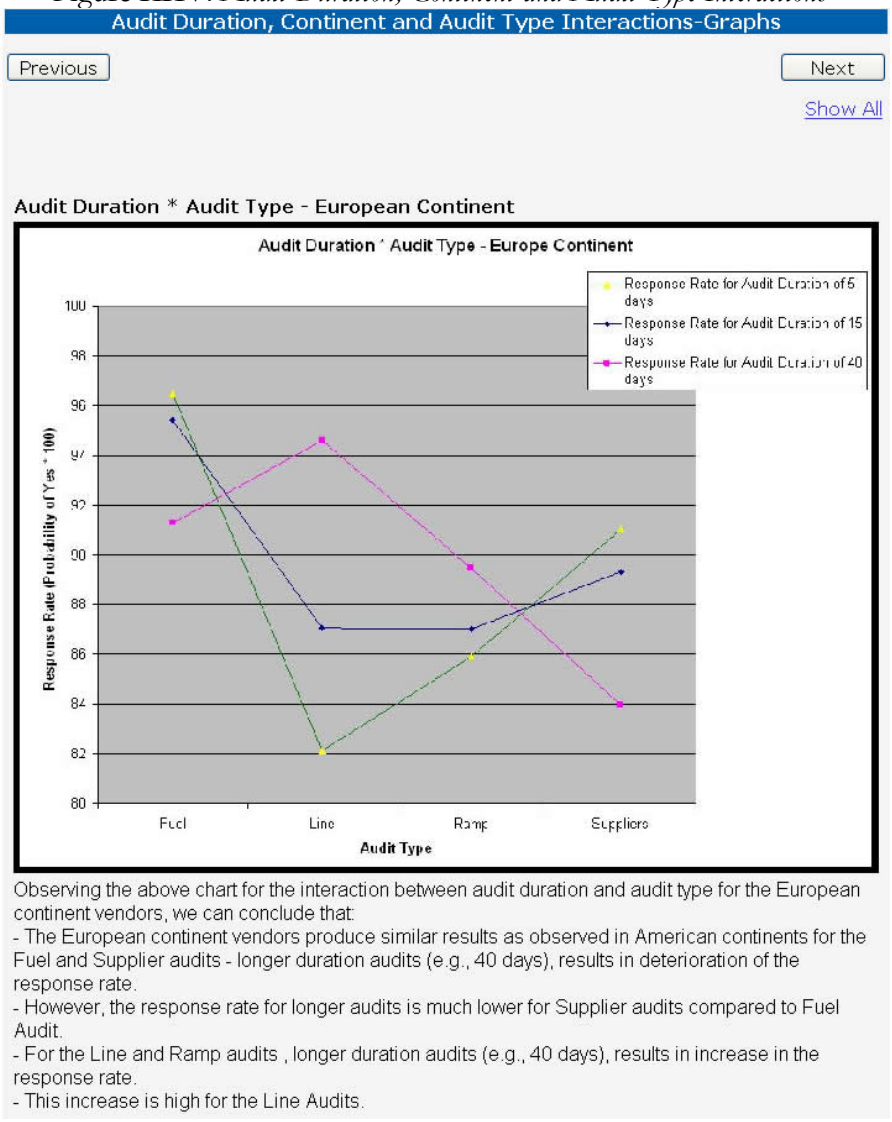


The Audit Duration, Continent and Audit Type Interactions page can be reached from the Auditor Experience and Continent Interactions page or by using

the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to understand the effect of the interactions between the audit duration and audit type and between the audit duration and vendor location on the response rate, as shown in Figure XXV. The graphical image displayed is contextual albeit static in nature. The tool displays the appropriate image based on the selections made in the Audit Impact page. Since the auditor chose a vendor from the European continent in the Audit Impact page, the tool displays the interaction for the European continent (as shown in Figure XXV).

The auditor can click on the Show All link, to view the effect of the interaction for all continents. The auditor can click on the Previous button to return to the Auditor Experience and Continent Interactions page. The auditor can also click on the Next button and proceed to the Predicted Response Rate page.

Figure XXV. *Audit Duration, Continent and Audit Type Interactions*

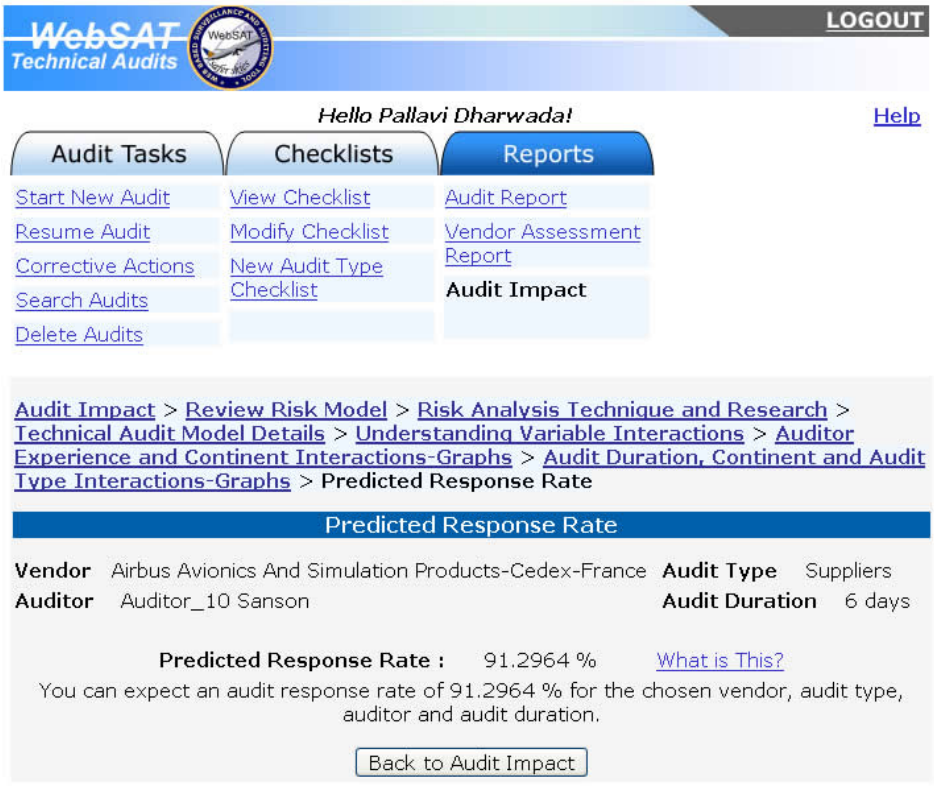


Observing the above chart for the interaction between audit duration and audit type for the European continent vendors, we can conclude that:
- The European continent vendors produce similar results as observed in American continents for the Fuel and Supplier audits - longer duration audits (e.g., 40 days), results in deterioration of the response rate.
- However, the response rate for longer audits is much lower for Supplier audits compared to Fuel Audit.
- For the Line and Ramp audits , longer duration audits (e.g., 40 days), results in increase in the response rate.
- This increase is high for the Line Audits.

The Predicted Response Rate page can be reached from the Audit Duration, Continent and Audit Type Interactions page or from the Effect of Variables on Vendor Performance page. The auditor views the model's predicted response rate based on the selections made in the Audit Impact page, as shown in Figure XXVI.

The auditor can click on the What is This? link, to understand the purpose of the Predicted Response Rate page. The auditor can click on the Back to Audit Impact button to return to the Audit Impact page.

Figure XXVI. *Predicted Response Rate*

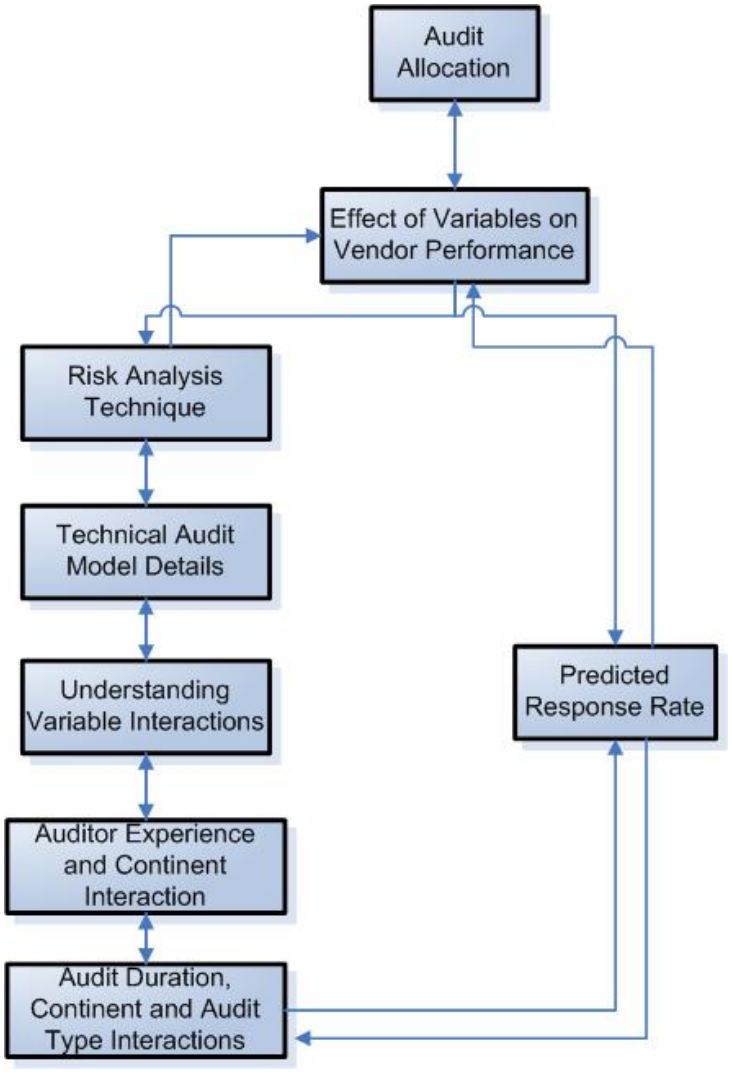


5.4.2 Technical Audit Screens- Audit Allocation

The product map for the Audit Allocation screens is shown in Figure XXVII.

The product map displays the navigation across the Audit Allocation screens.

Figure XXVII. *Audit Allocation Product Map*



The details on the screens in the Audit Allocation section are presented in the figures below. When the manager clicks on the Audit Allocation link on the global navigation "Reports" tab of the Technical Audit module, the Audit Allocation page is revealed. The manager can perform two tasks in this page:

1. Select the number of allocations to be made from the drop down menu and click on the Calculate Predicted Response Rate button to specify variable

values and begin using the Audit Allocation tool as shown in Figure XXVIII (a) and (b).

2. Click on the What is this page about? link to understand the purpose of the Audit Allocation tool (See Figure XXIX).

Figure XXVIII (a). *Audit Allocation Screen*

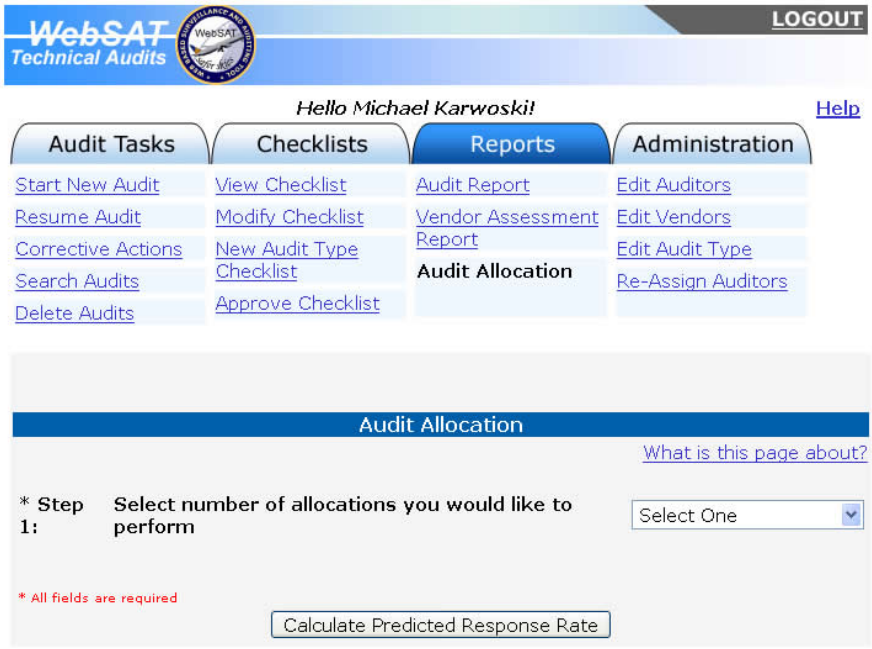
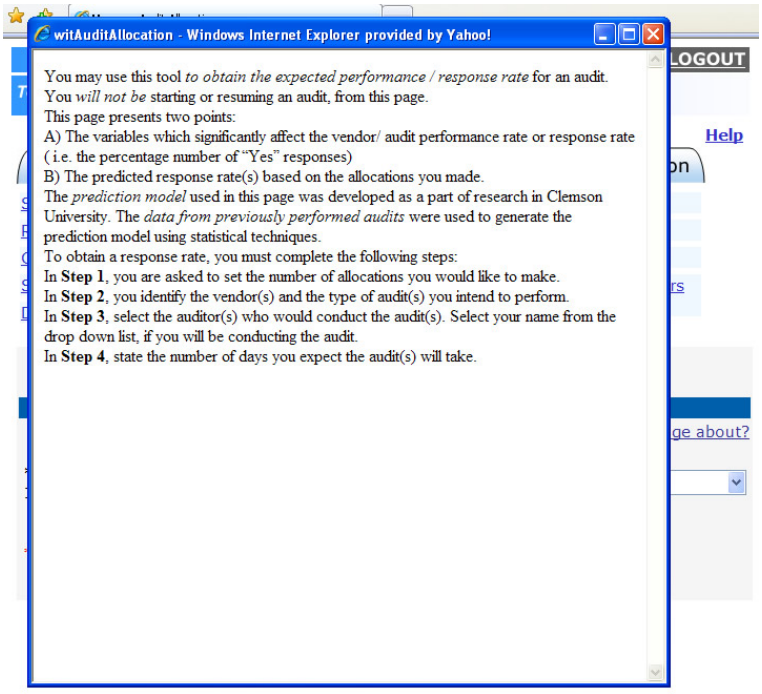


Figure XXVIII (b). *Audit Allocation Screen*

Figure XXIX. *What is this page about?*

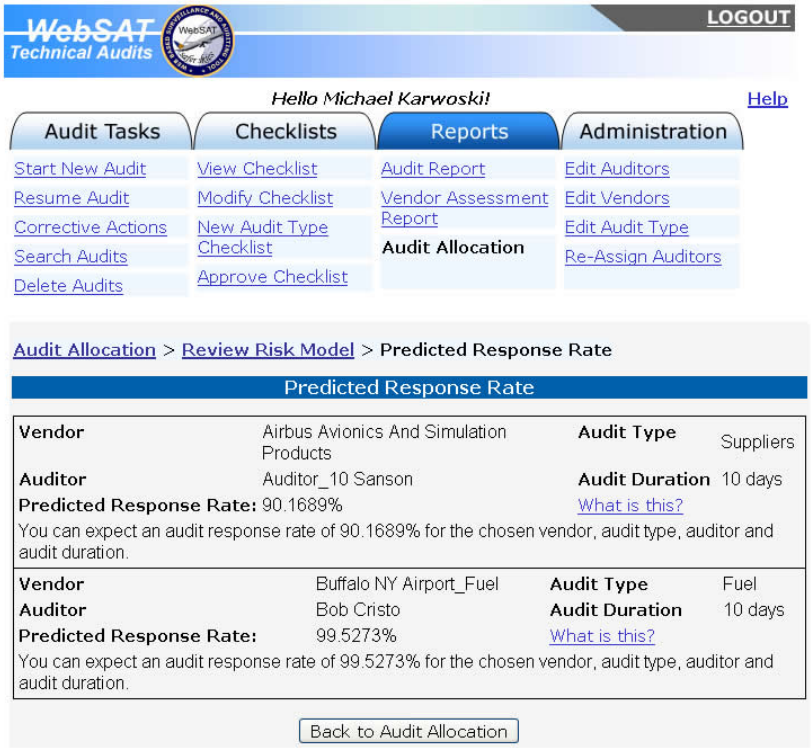


The subsequent pages are identical to the Audit Impact screens. The Auditor Experience and Continent Interactions page and Audit Duration, Continent and Audit Type Interactions page are also identical to those displayed in the Audit Impact section. The graphical image displayed is contextual albeit static in nature. Consequently, if the manager performs more than one allocation, multiple graphs may be displayed by the tool in each interaction page.

The Predicted Response Rate page can be reached from the Audit Duration, Continent and Audit Type Interactions page or from the Effect of Variables on Vendor Performance page. The manager views the model's predicted response rates based on the selections made in the Audit Allocation page, as shown in Figure XXX.

The manager can click on the What is This? link, to understand the purpose of the Predicted Response Rate page. The manager can click on the Back to Audit Allocation button to return to the Audit Allocation page.

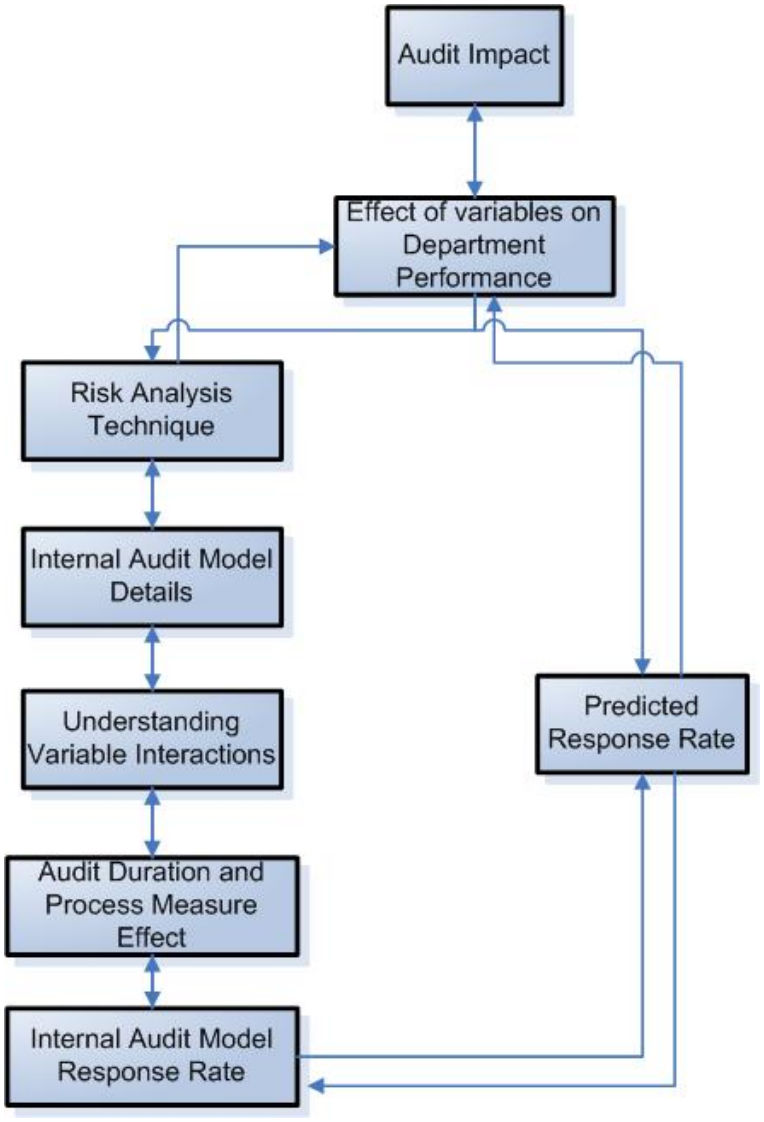
Figure XXX. *Predicted Response Rate*



5.4.3 Internal Audit Module Screens- Audit Impact

The product map for the Internal Audit module's Audit Impact screens is shown in Figure XXXI. The product map displays the navigation across the Audit Impact screens.

Figure XXXI. *Internal Audit Module Audit Impact Product Map*



The details on the screens in the Audit Impact section are presented in the figures below. When the auditor clicks on the Audit Impact link on the global navigation "Reports" tab of the Internal Audit module, the Audit Impact page is revealed. The auditor can perform two tasks in this page, as shown in Figure XXXII:

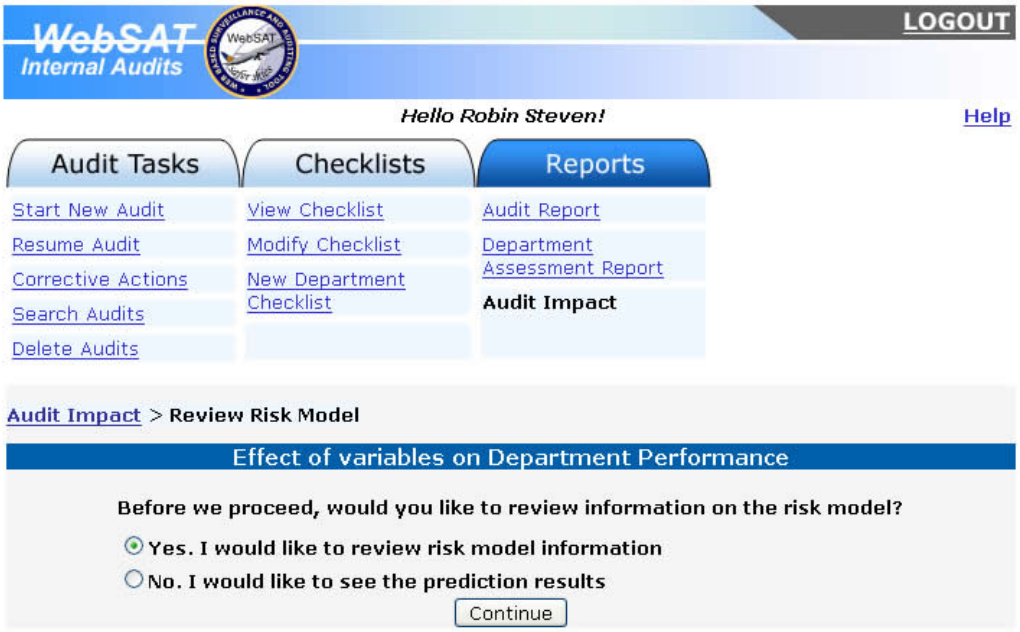
1. Select choices from the drop down menus, enter information in the text box and click on the Calculate Predicted Response Rate button to begin using the Audit Impact tool.

2. Click on the What is this page about? link to understand the purpose of the Audit Impact tool.

Figure XXXII. *Audit Impact Screen*

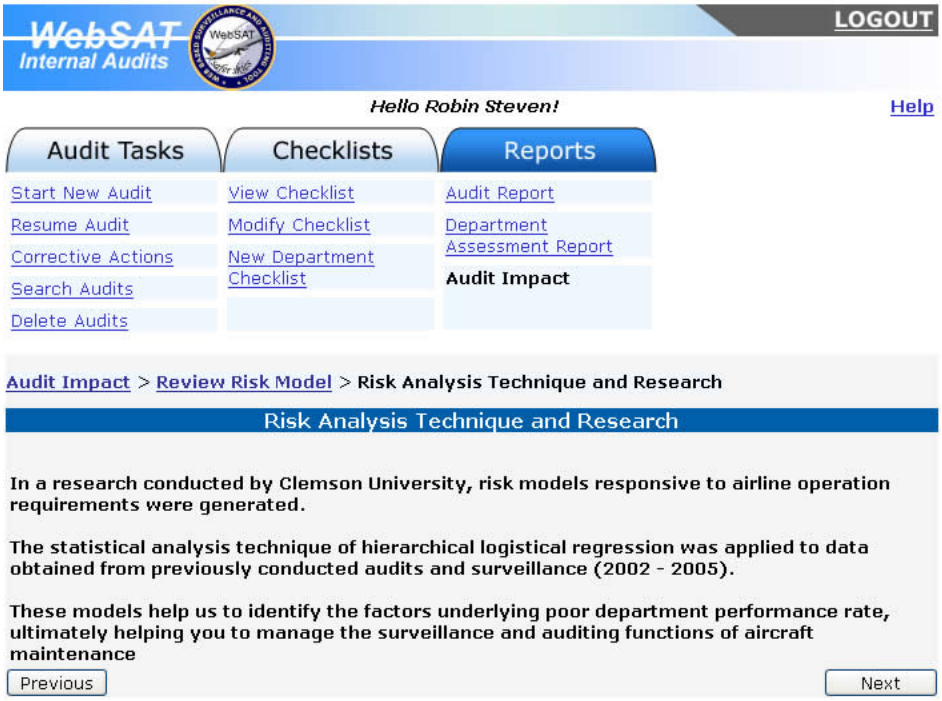
The Effect of Variables on Department Performance page can be reached from the Audit Impact page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page gives the auditor the option to review the model information or view the prediction results, as shown in Figure XXXIII. The first radio button choice of "Yes. I would like to review risk model information" is set as the default option. The auditor can also choose the other option and click on the Continue button to proceed to the prediction results.

Figure XXXIII. *Effect of Variables on Department Performance*



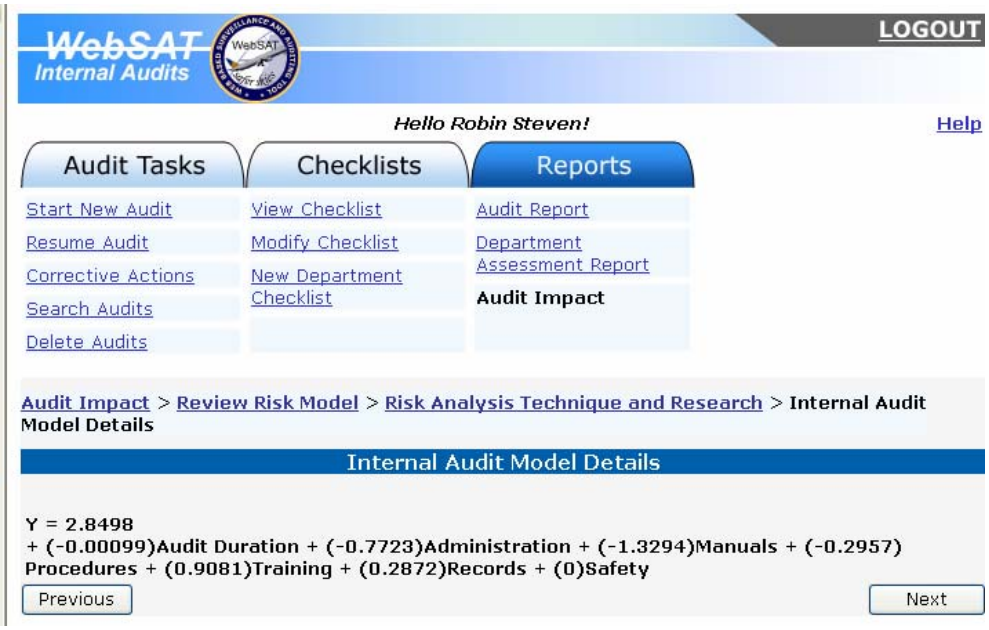
The Risk Analysis Technique and Research page can be reached from the Effect of Variables on Department Performance page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page gives the auditor a review of the research involved in the development of the model, as shown in Figure XXXIV. The auditor can click on the Previous button to return to the Effect of Variables on Department Performance page. The auditor can also click on the Next button and proceed to the next page in the model review section.

Figure XXXIV. *Risk Analysis Technique and Research*



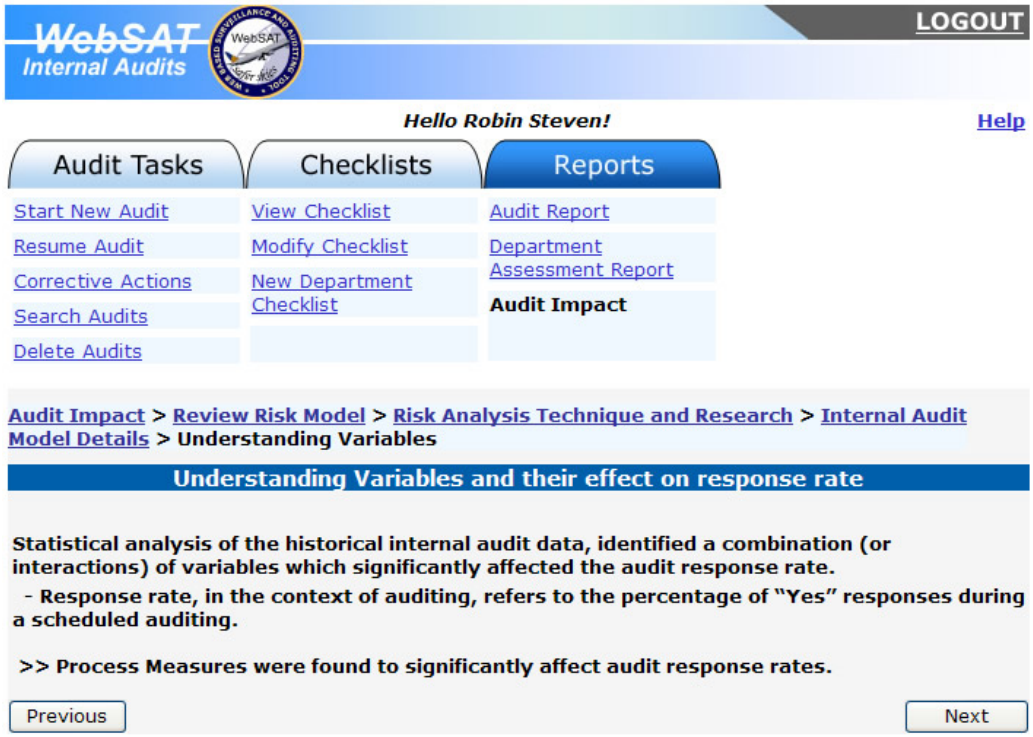
The Internal Audit Model Details page can be reached from the Risk Analysis Technique and Research page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to view the general structure of the model, as shown in Figure XXXV. The auditor can click on the Previous button to return to the Risk Analysis Technique and Research page. The auditor can also click on the Next button and proceed to the next page in the model review section.

Figure XXXV. *Internal Audit Model Details - General Model Structure*



The Understanding Variables page can be reached from the Internal Audit Model Details page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to understand the predictor variables that significantly affect the response rate, as shown in Figure XXXVI. The auditor can click on the Previous button to return to the Internal Audit Model Details page. The auditor can also click on the Next button and proceed to the next page in the model review section.

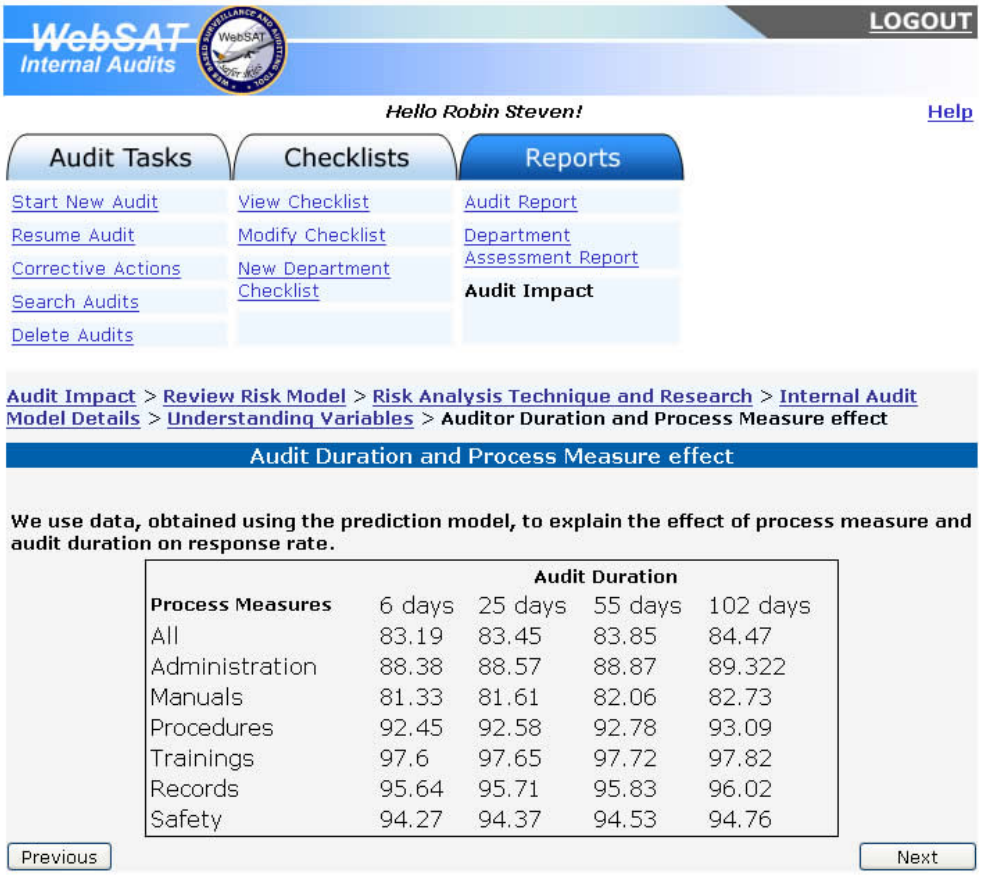
Figure XXXVI. *Understanding Variable Interactions*



The Audit Duration and Process Measure Effect page can be reached from the Understanding Variables page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to understand the effect of the process measure on the response rate, as shown in Figure XXXVII. The tool displays a table with different values of audit duration and different process measures. This table is static in nature and does not change based on the selection made in the Audit Impact page.

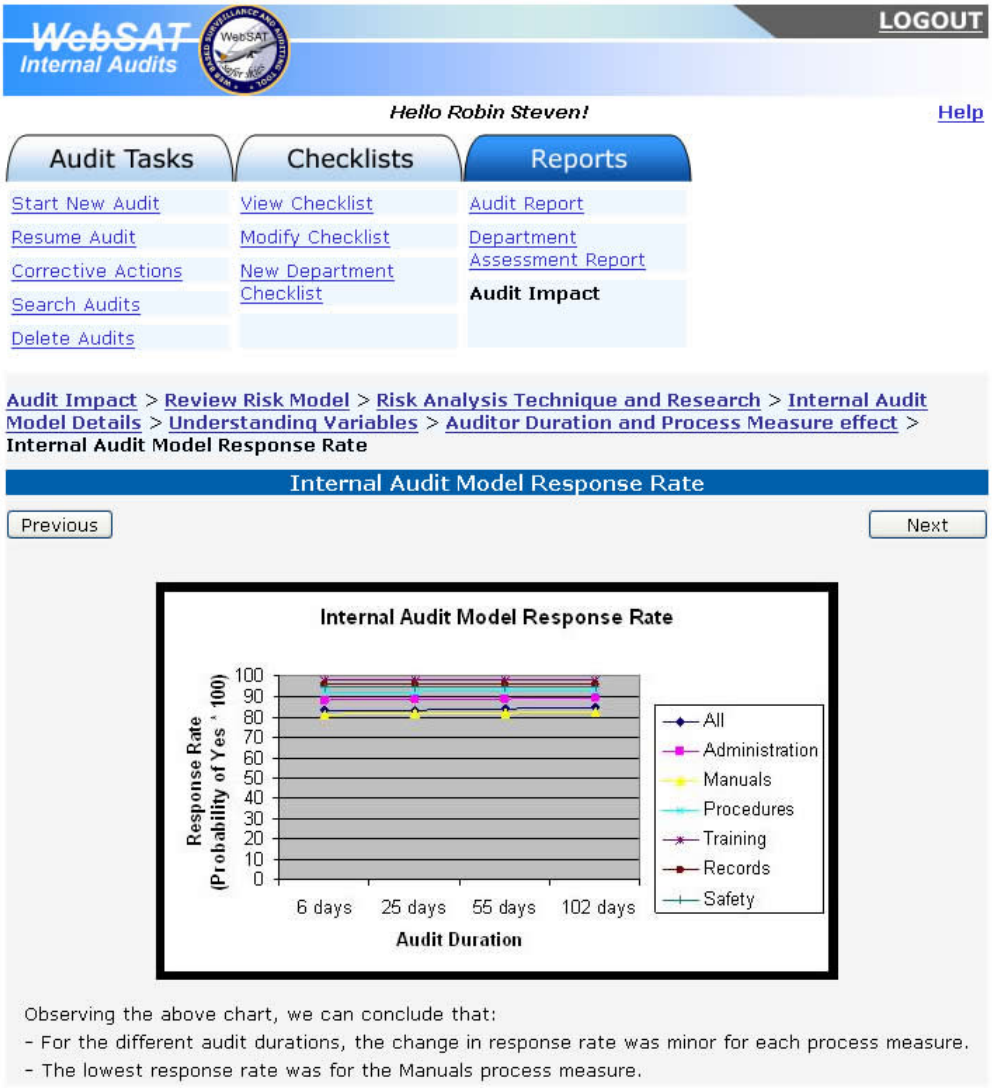
The auditor can click on the Previous button to return to the Understanding Variables page. The auditor can also click on the Next button and proceed to the next page in the model review section.

Figure XXXVII. *Audit Duration and Process Measure Effect*



The Internal Audit Model Response Rate page can be reached from the Audit Duration and Process Measure Effect page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the auditor to understand the effect of process measure on the response rate with different audit durations, as shown in Figure XXXVIII. The graphical image displayed is static in nature and is independent of the selection made in the Audit Impact page. The auditor can click on the Previous button to return to the Audit Duration and Process Measure Effect page. The auditor can also click on the Next button and proceed to the next page in the model review section.

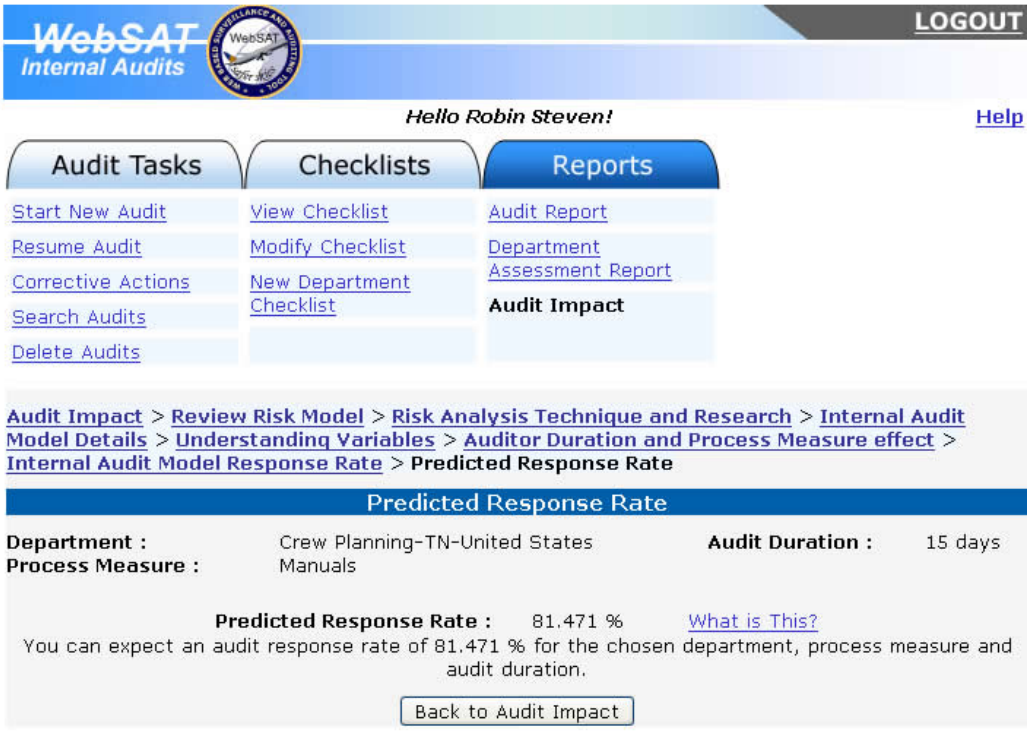
Figure XXXVIII. *Internal Audit Model Response Rate*



The Predicted Response Rate page can be reached from the Internal Audit Model Response Rate page or from the Effect of Variables on Department Performance page. The auditor views the model's predicted response rate based on the selections made in the Audit Impact page, as shown in Figure XXXIX.

The auditor can click on the What is This? link, to understand the purpose of the Predicted Response Rate page. The auditor can click on the Back to Audit Impact button to return to the Audit Impact page.

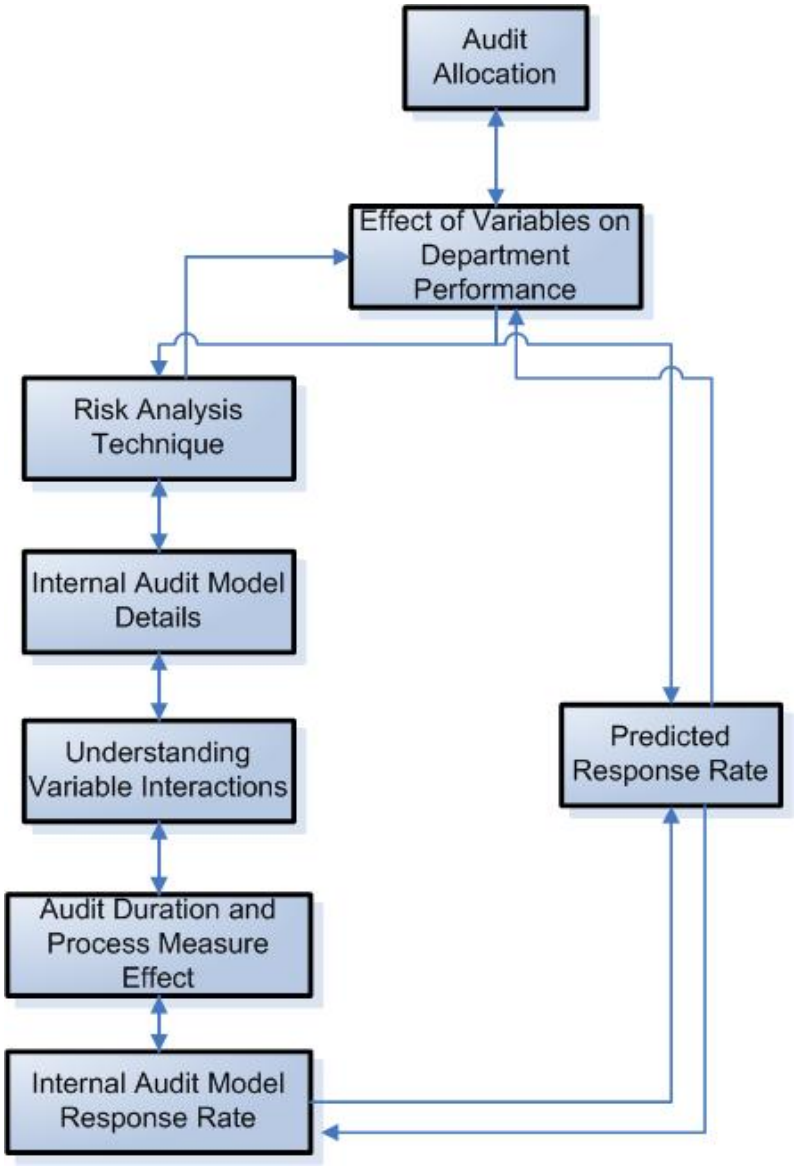
Figure XXXIX. *Predicted Response Rate*



5.4.3 Internal Audit Screens- Audit Allocation

The product map for the Audit Allocation screens is shown in Figure XL. The product map displays the navigation across the Audit Allocation screens.

Figure XL. *Audit Allocation Product Map*



The details on the screens in the Audit Allocation section are presented in the figures below. When the manager clicks on the Audit Allocation link on the global navigation "Reports" tab of the Internal Audit module, the Audit Allocation page is revealed. The manager can perform two tasks in this page:

1. Select the number of allocations to be made from the drop down menu and click on The Calculate Predicted Response Rate button to specify variable

values and begin using the Audit Allocation tool as shown in Figure XLI (a) and (b).

2. Click on the What is this page about? link to understand the purpose of the Audit Allocation tool.

Figure XLI (a). *Audit Allocation Screen*

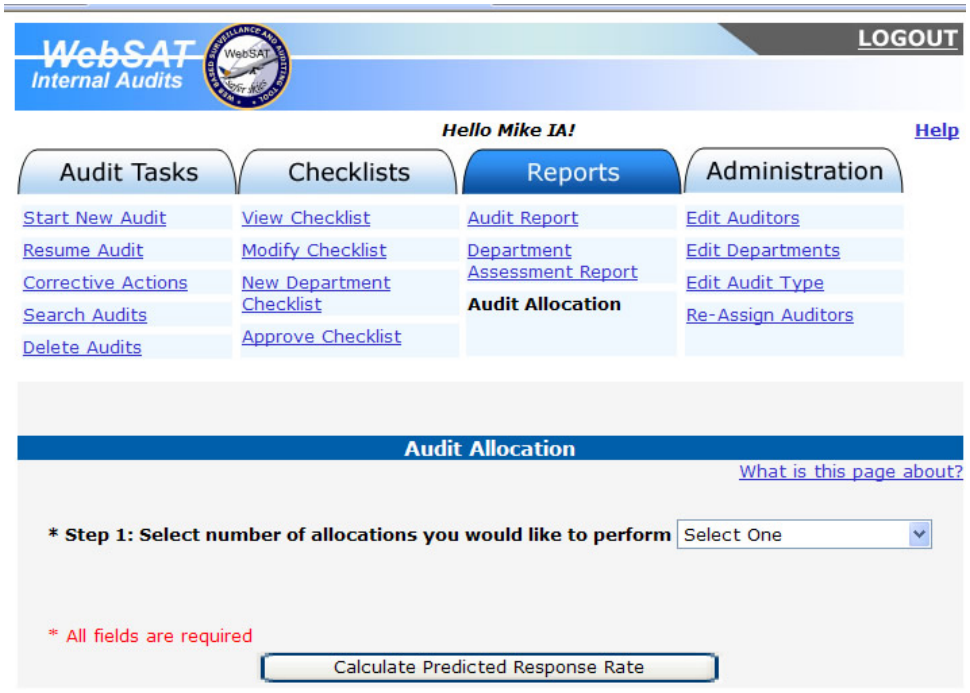
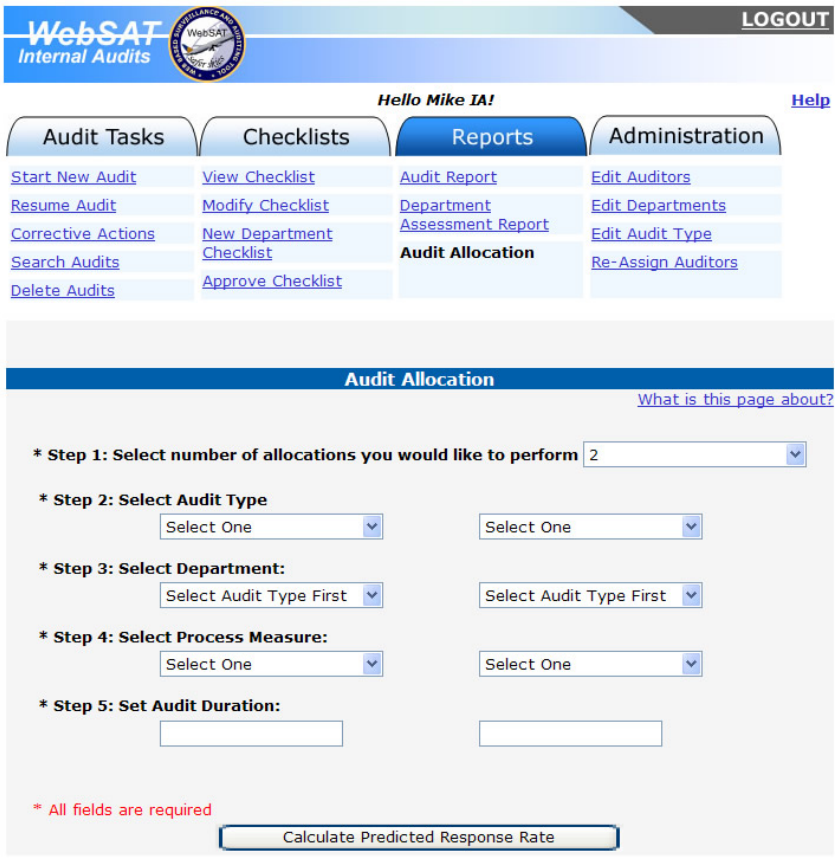


Figure XLI (b). *Audit Allocation Screen*

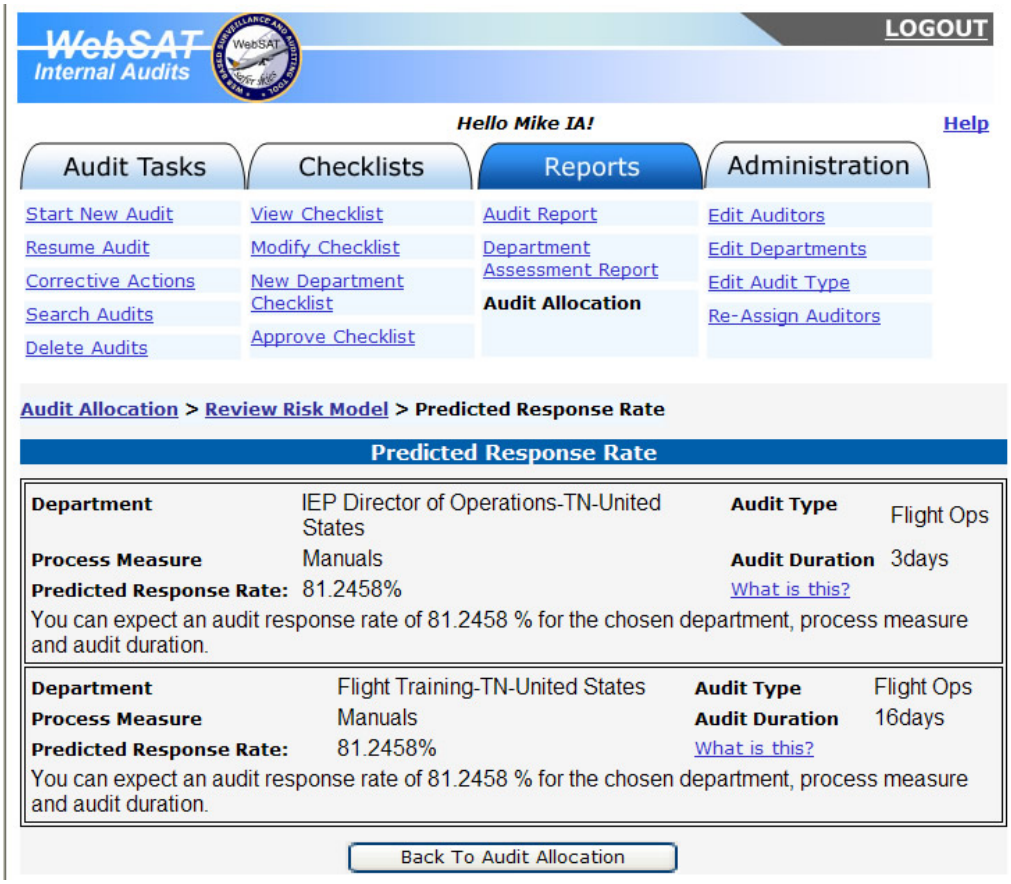


The subsequent pages are identical to the Audit Impact screens. The Audit Duration and Process Measure Effect page and Internal Audit Model Response Rate page are also identical to those displayed in Audit Impact section.

The Predicted Response Rate page can be reached from the Internal Audit Model Response Rate page or from the Effect of Variables on Department Performance page. The manager views the model's predicted response rates based on the selections made in the Audit Allocation page, as shown in Figure XLII.

The manager can click on the Back to Audit Allocation button to return to the Audit Allocation page.

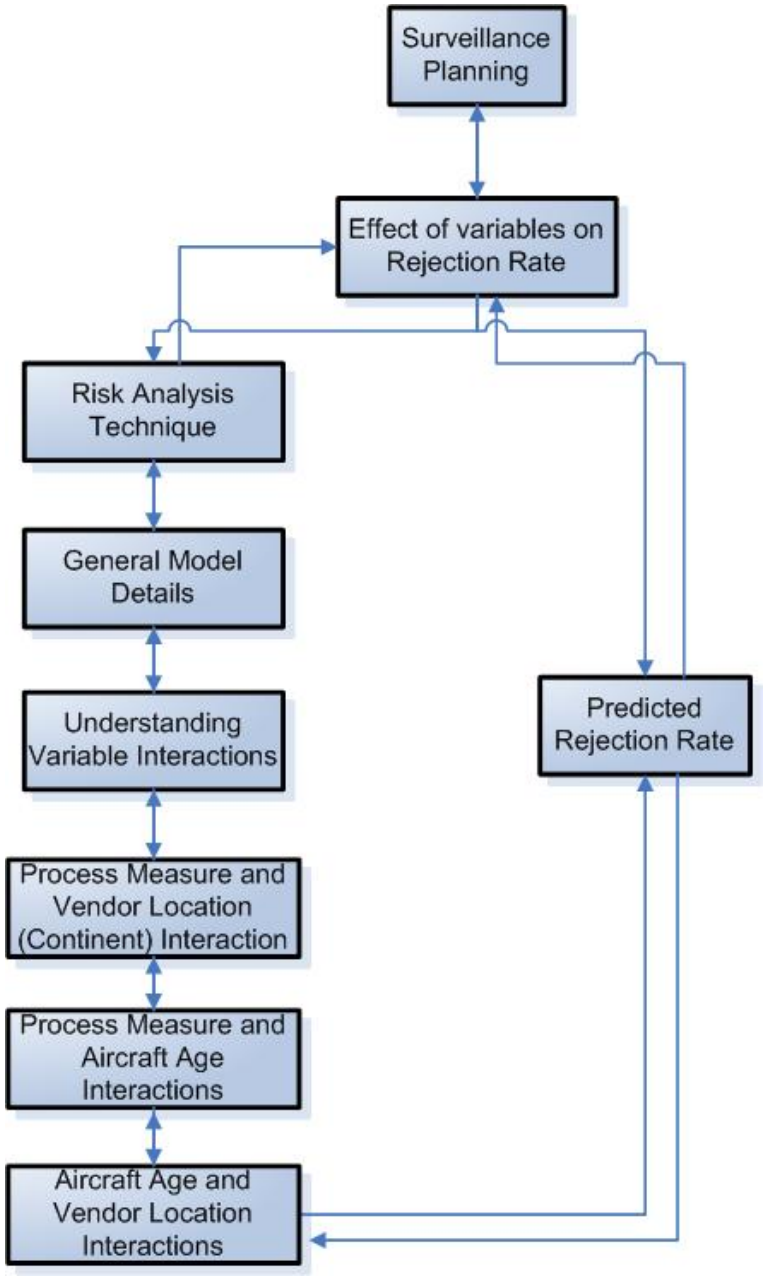
Figure XLII. *Predicted Response Rate*



5.4.5 Surveillance Module Screens- Surveillance Planning (Surveillance Representative)

The product map for the Surveillance module's Surveillance Planning screens is shown in Figure XLIII. This product map displays the navigation across the Surveillance Planning screens accessible to the surveillance representatives.

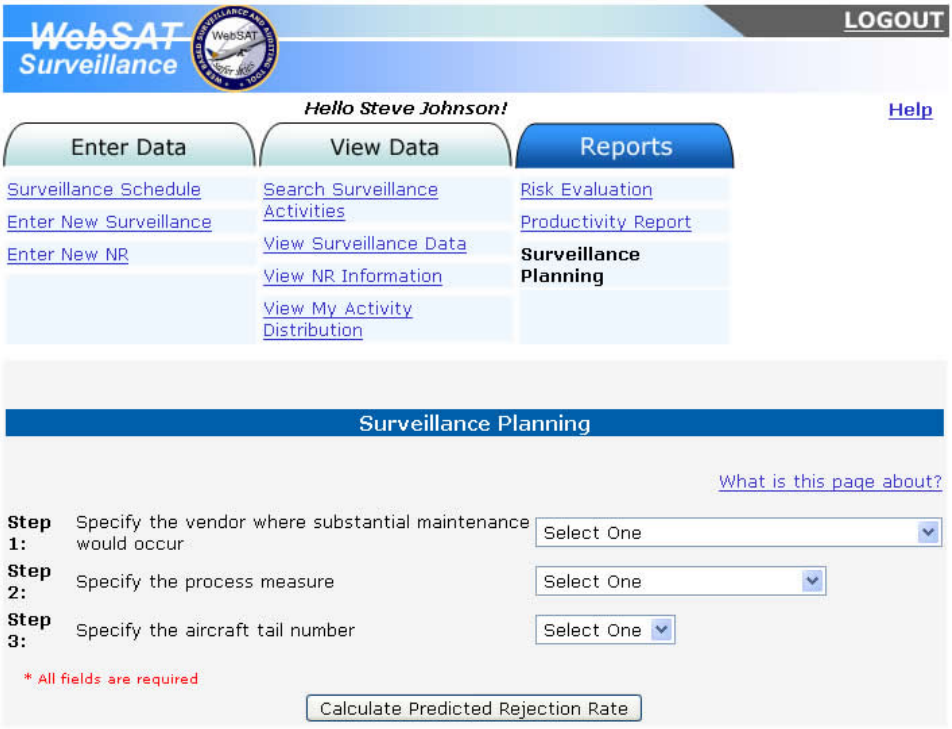
Figure XLIII. *Surveillance Planning Product Map*



The details on the screens in the Surveillance Planning section are presented in the figures below. When the surveillance representative clicks on the Surveillance Planning link on the global navigation "Reports" tab of the Surveillance module, the Surveillance Planning page is revealed. The representative can perform two tasks in this page, as shown in Figure XLIV:

1. Select choices from the drop down menus, enter information in the text box and click on The Calculate Predicted Rejection Rate button to begin using the Surveillance Planning tool.
2. Click on the What is this page about? link to understand the purpose of the Surveillance Planning tool.

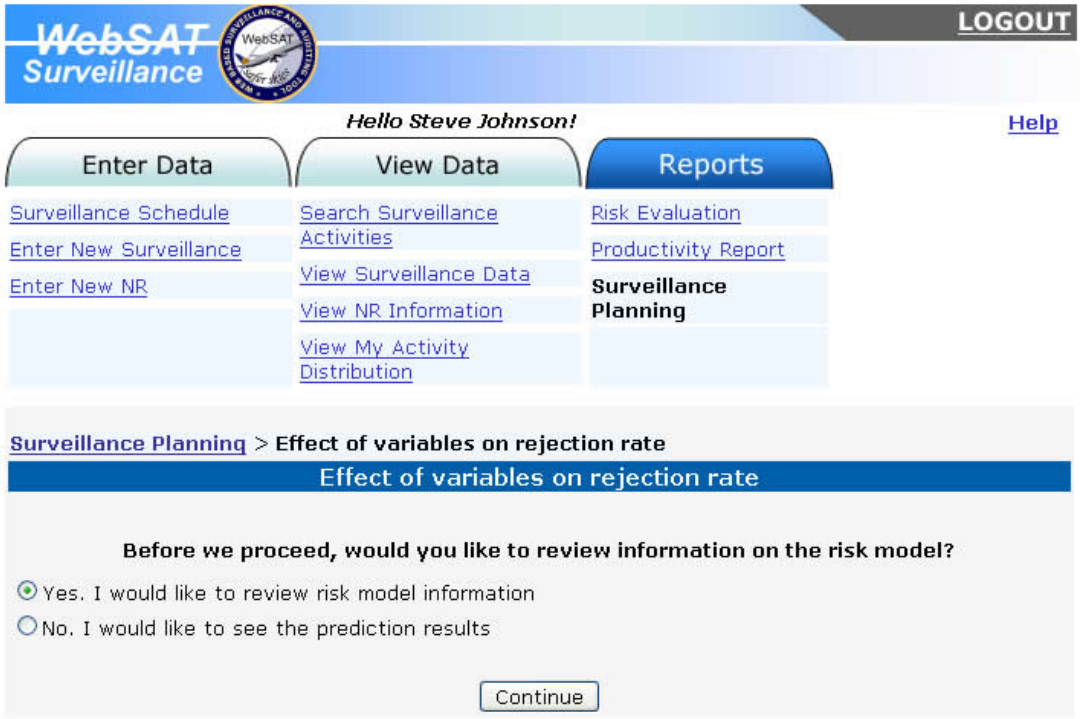
Figure XLIV. *Surveillance Planning Screen- Surveillance Representative*



The Effect of Variables on Rejection Rate page can be reached from the Surveillance Planning page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page gives the representative the choice if he/she would like to review the model information or view the prediction results, as shown in Figure XLV. The first radio button choice of "Yes. I would like to review risk model information" is set as the default option. The representative can also

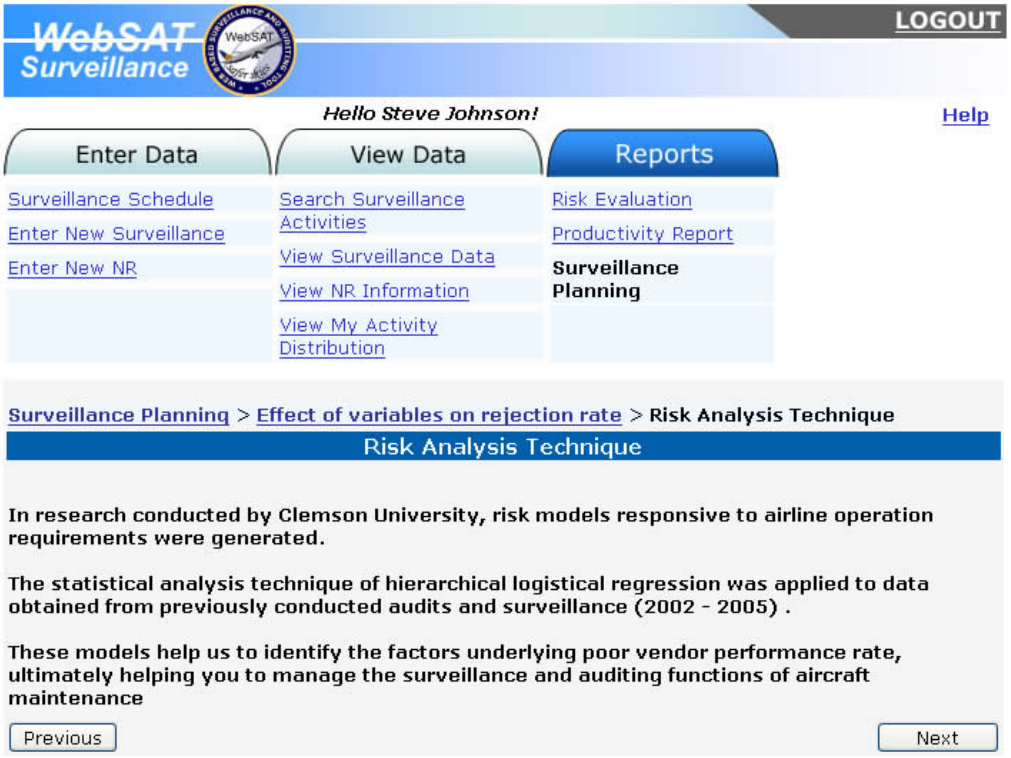
choose the other option and click on the Continue button to proceed to the prediction results.

Figure XLV. *Effect of Variables on Rejection Rate*



The Risk Analysis Technique page can be reached from the Effect of Variables on Rejection Rate page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page gives the representative a review of the research involved in the development of the model, as shown in Figure XLVI. The representative can click on the Previous button to return to the Effect of Variables on Rejection Rate page. The representative can also click on the Next button and proceed to the next page in the model review section.

Figure XLVI. *Risk Analysis Technique*



The Surveillance Model Details page can be reached from the Risk Analysis Technique page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the representative to view the general structure of the model, as shown in Figure XLVII (a). The representative can also click on the View Detailed Model link to see the detailed model which includes the values of the coefficients of the model variables, as shown in Figure XLVII (b). The representative can click on the Previous button to return to the Risk Analysis Technique page. The representative can also click on the Next button and proceed to the next page in the model review section.

Figure XLVII (a). *Surveillance Model Details - General Model Structure*

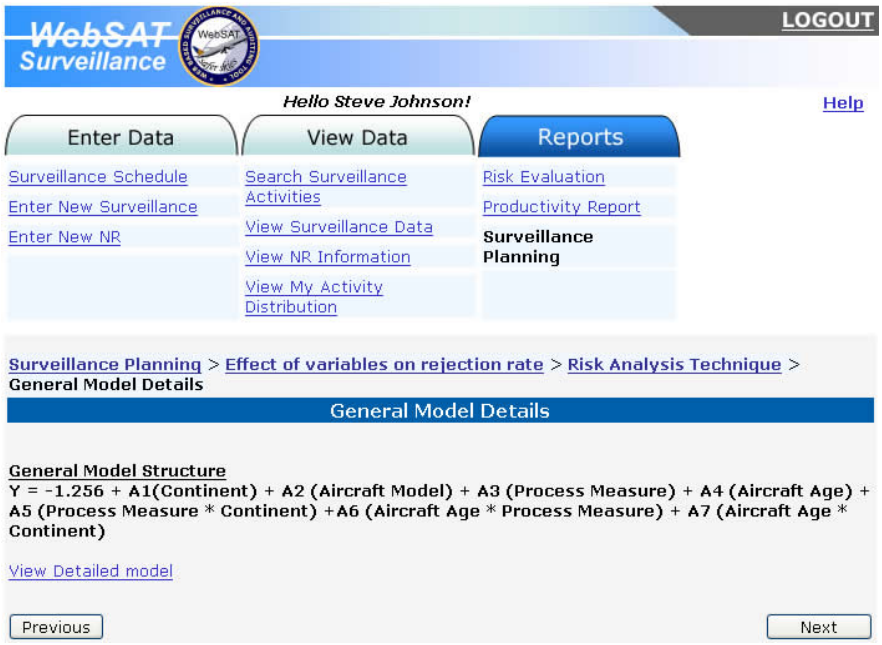
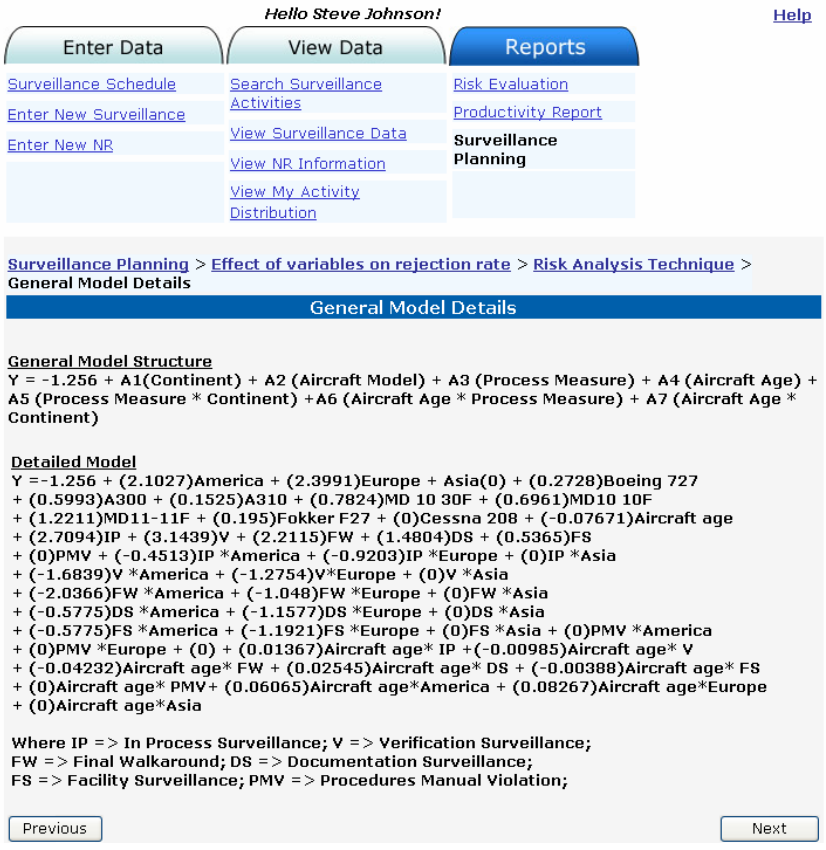
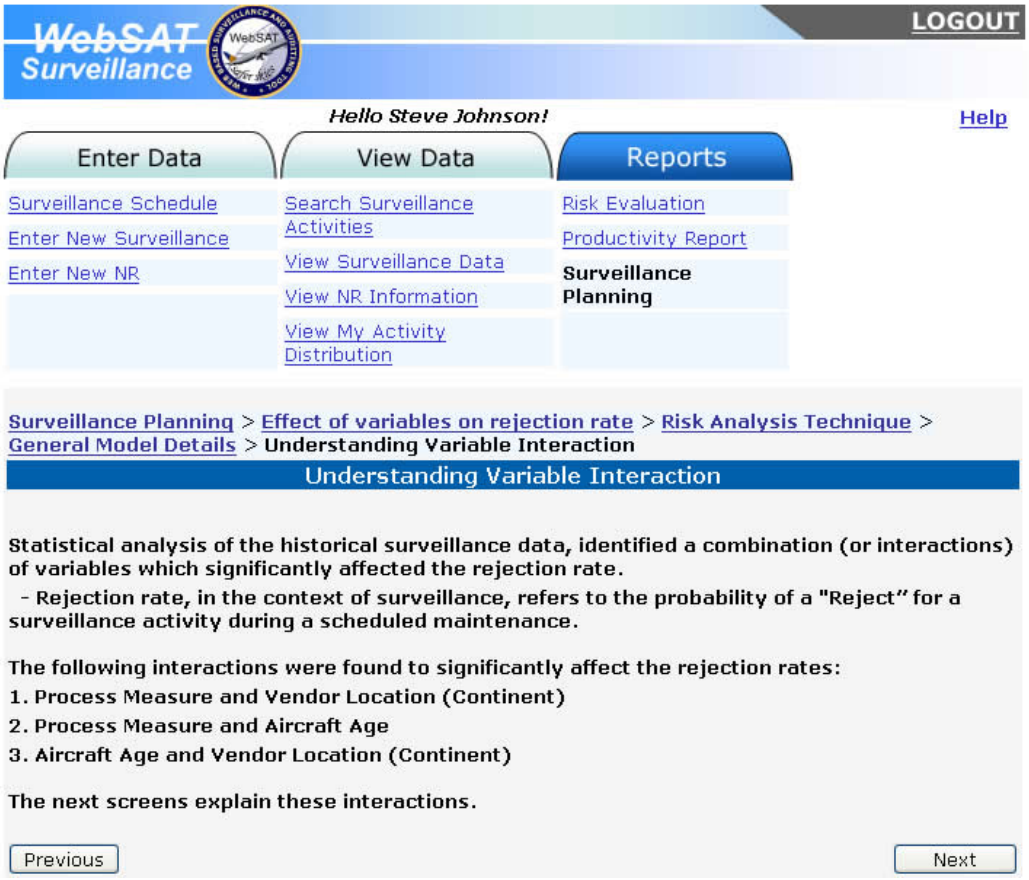


Figure XLVII (b). *Surveillance Model Details – Detailed Model*



The Understanding Variable Interaction page can be reached from the Surveillance Model Details page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the representative to understand the predictor variables and their interactions that significantly affect the rejection rate, as shown in Figure XLVIII. The representative can click on the Previous button to return to the Surveillance Model Details page. The representative can also click on the Next button and proceed to the next page in the model review section.

Figure XLVIII.*Understanding Variable Interaction*

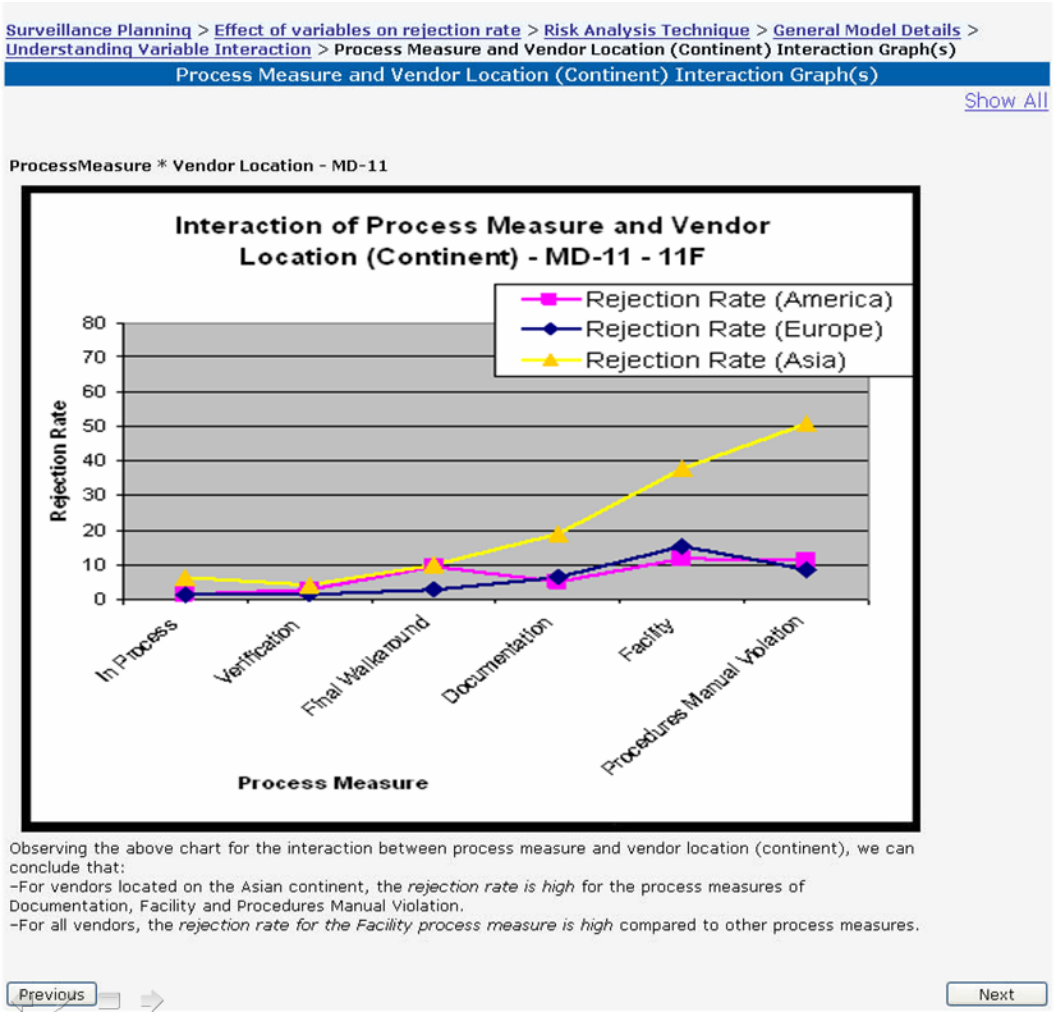


The Process Measure and Vendor Location (Continent) Interaction page can be reached from the Understanding Variable Interaction page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page

allows the representative to understand the effect of the interaction between process measure and vendor location on the rejection rate, as shown in Figure XLIX. The graphical image displayed is contextual albeit static in nature. The tool displays the appropriate image based on the selections made in the Surveillance Planning page. Since the representative chose an aircraft tail number of type MD-11-11F in the Surveillance Planning page, the tool displays the interaction between the process measure and vendor location on the rejection rate for the MD 11-11F aircraft type (as shown in Figure XLIX).

The representative can click on the Show All link, to view the effect of the interaction between process measure and vendor location on the rejection rate for all aircraft types. The representative can click on the Previous button to return to the Understanding Variable Interaction page. The representative can also click on the Next button and proceed to the next page in the model review section.

Figure XLIX. *Process Measure and Vendor Location (Continent) Interactions*

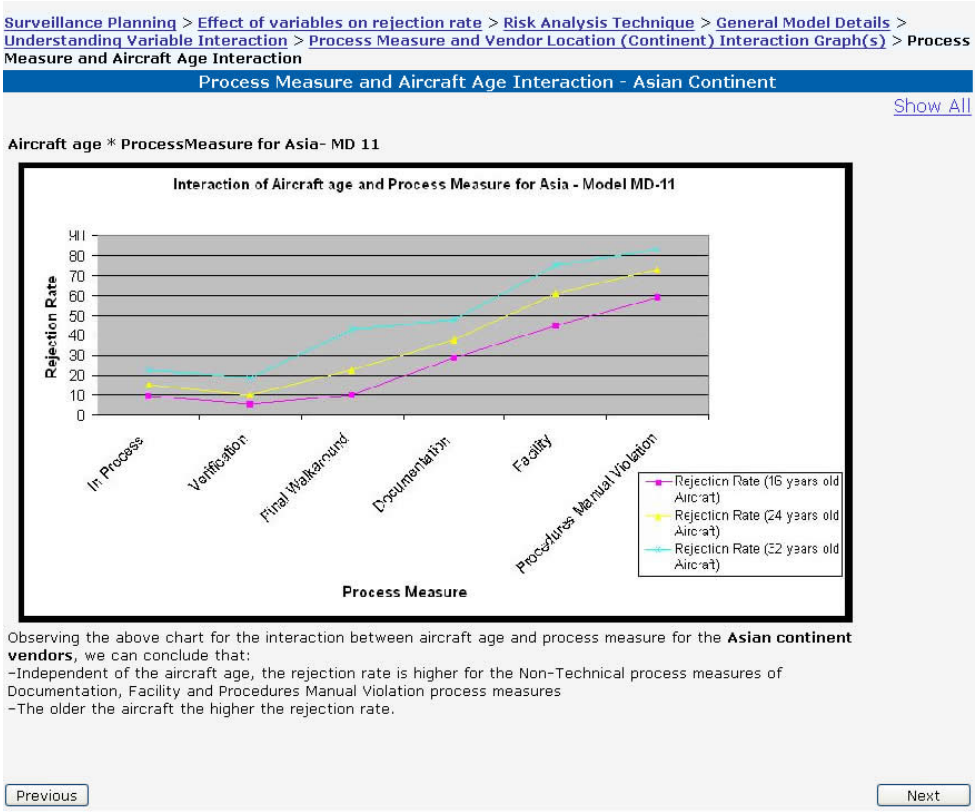


The Process Measure and Aircraft Age Interaction page can be reached from the Process Measure and Vendor Location (Continent) Interaction page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the representative to understand the effect of the interaction between the process measure and aircraft on the rejection rate, as shown in Figure L. The graphical image displayed is contextual albeit static in nature. The tool displays the appropriate image based on the selections made in the Surveillance Planning page. Since the representative chose a vendor from the Asian continent in the Surveillance

Planning page, the tool displays the interaction for the Asian continent (as shown in Figure L).

The representative can click on the Show All link, to view the effect of the interaction for all the aircraft in the Asian continent. The representative can click on the Previous button to return to the Process Measure and Vendor Location (Continent) Interaction page. The representative can also click on the Next button and proceed to the next page.

Figure L. *Process Measure and Aircraft Age Interaction*

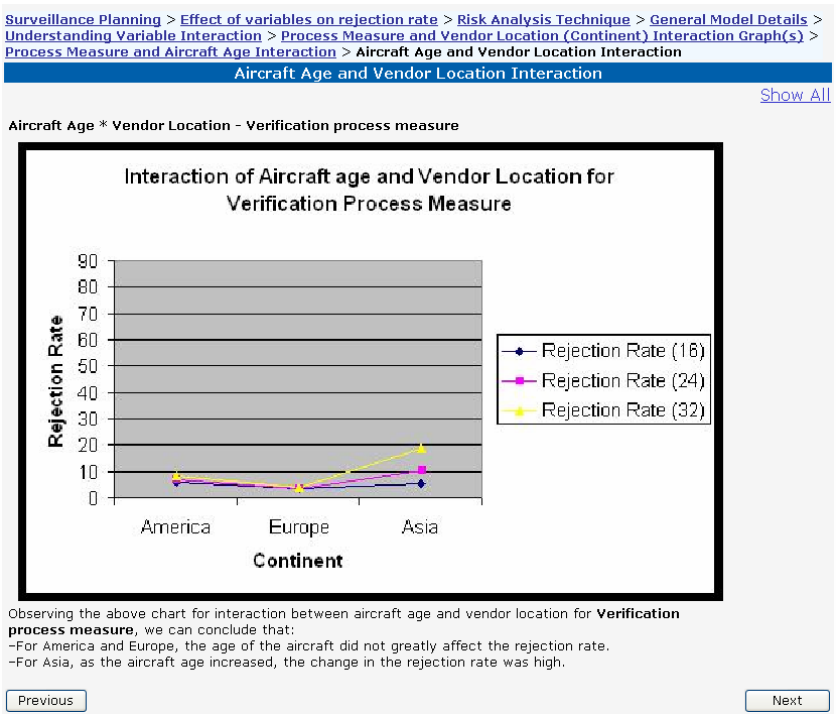


The Aircraft Age and Vendor Location Interaction page can be reached from the Process Measure and Aircraft Age Interaction page or by using the links in the breadcrumb available below the links in the global navigation tabs. This page allows the representative to understand the effect of the interaction between the aircraft age

and vendor location on the response rate, as shown in Figure LI. The graphical image displayed is contextual albeit static in nature. The tool displays the appropriate image based on the selections made in the Surveillance Planning page. Since the representative chose the Verification process measure in the Surveillance Planning page, the tool displays the interaction for the Verification process measure (as shown in Figure LI).

The representative can click on the Show All link, to view the effect of the interaction for all process measures. The representative can click on the Previous button to return to the Process Measure and Aircraft Age Interaction page. The representative can also click on the Next button and proceed to the Predicted Rejection Rate page.

Figure LI. *Aircraft Age and Vendor Location Interaction*

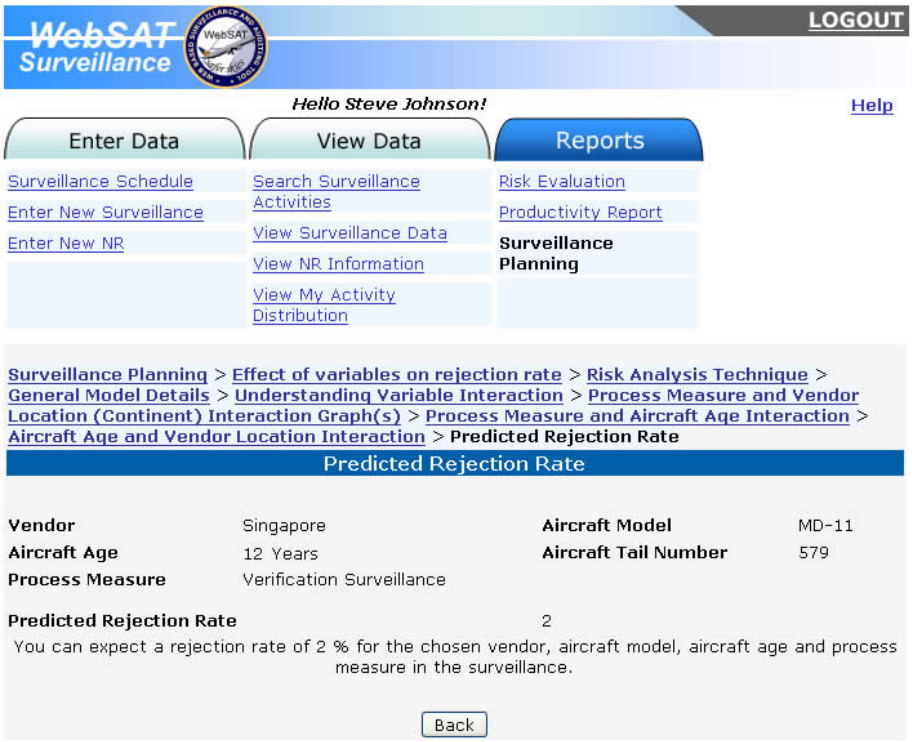


The Predicted Rejection Rate page can be reached from the Aircraft Age and Vendor Location Interaction page or from the Effect of Variables on Rejection Rate

page. The representative views the model's predicted response rate based on the selections made in the Surveillance Planning page, as shown in Figure LII.

The representative can also click on the Back button to return to the Surveillance Planning page.

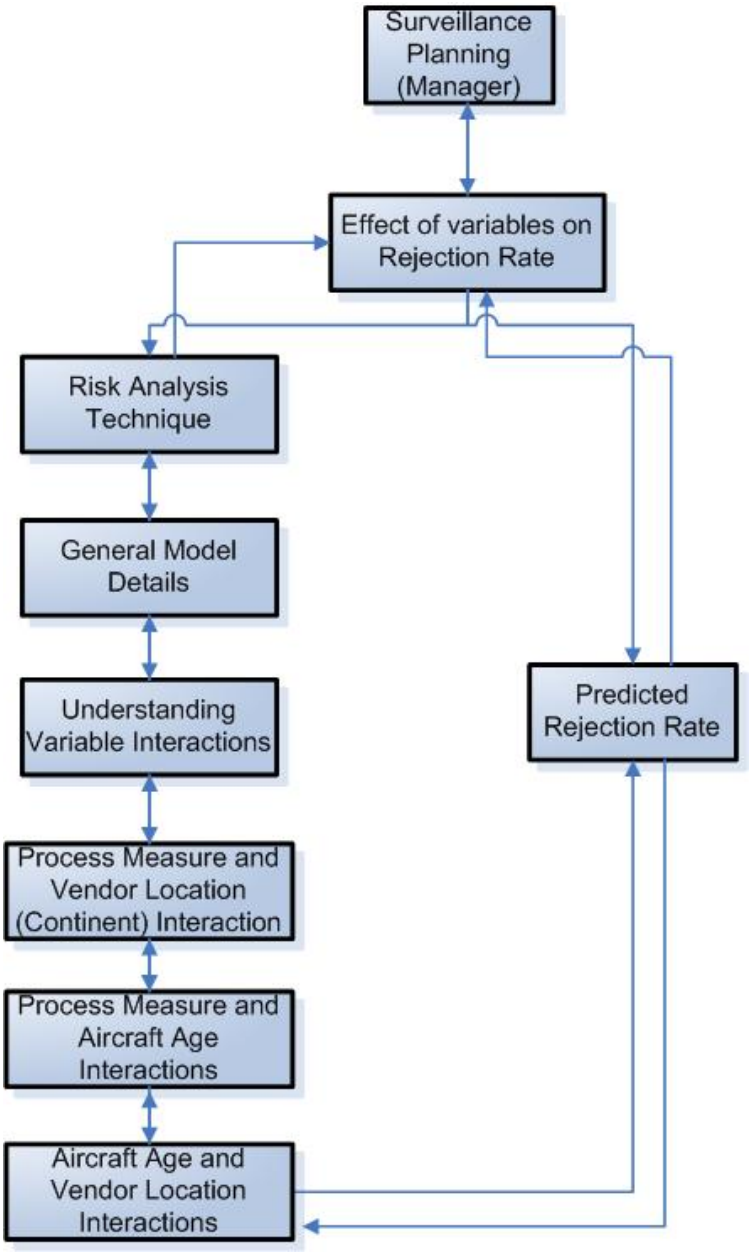
Figure LII. *Predicted Rejection Rate*



5.4.6 Surveillance Module Screens- Surveillance Planning (Manager)

The product map for the Surveillance Planning screens is shown in Figure LIII. The product map displays the navigation across the Surveillance Planning screens accessible to the surveillance managers.

Figure LIII. *Surveillance Planning Product Map*



The details on the screens in the Surveillance Planning section are presented in the figures below. When the manager clicks on the Surveillance Planning link on the global navigation "Reports" tab of the Surveillance module, the Surveillance Planning page is revealed. The manager can perform two tasks in this page:

1. Select the number of allocations to be made from the drop down menu and click on The Calculate Predicted Response Rate button to specify variable values and begin using the Surveillance Planning tool, as shown in Figure LIV (a) and (b).
2. Click on the What is this page about? link to understand the purpose of the Surveillance Planning tool.

Figure LIV (a). *Surveillance Planning Screen- Manager*

Figure LIV (b). *Surveillance Planning Screen - Manager*

The subsequent pages are identical to the representative's Surveillance Planning screens. The Process Measure and Vendor Location (Continent) Interaction page, Process Measure and Aircraft Age Interaction page and the Aircraft Age and Vendor Location Interaction page are also identical to those displayed in representative's Surveillance Planning section. The graphical images displayed are contextual albeit static in nature. Consequently, if the manager performs more than one allocation, multiple graphs may be displayed by the tool in each interaction page.

The Predicted Rejection Rate page can be reached from the Aircraft Age and Vendor Location Interaction page or from the Effect of Variables on Rejection Rate

page. The manager views the model's predicted rejection rates based on the selections made in the Surveillance Planning page, as shown in Figure LV.

The manager can also click on the Back button to return to the Surveillance Planning page.

Figure LV. *Predicted Rejection Rate*

5.5 Interface Evaluation and Model Experiments

The interface evaluation was conducted to evaluate the prototype for the usability of the above features presented in the tool. The typical task performance measures which were accounted for are:

1. The time the user takes to complete a task.
2. The ease of use of the Prediction and Planning tool.

A standardized usability subjective satisfaction survey was conducted using the Software Usability Measurement Inventory (SUMI). SUMI is a consistent method for assessing the quality of use of a software product or prototype, and can

assist with the detection of usability flaws before a product is shipped (Veenendaal, 1998). SUMI is a rigorously tested and validated method to measure software quality from a user perspective. Using SUMI the usability of the Prediction and Planning tool was evaluated in a standardized and objective manner. In addition to the SUMI questionnaire, a short feedback questionnaire was also used in the experiment to collect the participants' feedback on the Prediction and Planning tools (See Appendix O). The questionnaire has six criteria to be rated by the participant on a scale of 1 to 7 where 7 indicates system satisfied the criterion completely and 1 indicates system barely satisfied the criterion.

Further, the evaluation also tested the three research hypotheses listed below:

The Prediction Capability and Impact Experiment: Validation of the Utility of the Model

The models' validity was ascertained by integrating it with the WebSAT tool as a part of its data analysis functionality. The effectiveness of the model was studied in a controlled experiment with prospective WebSAT users.

Hypothesis: The study tested the following hypotheses:

1. Prediction capability hypothesis (The Prediction Capability Experiment):
    a. H_0: There is no difference in vendor/department performance prediction capabilities between the WebSAT tool with the model and the WebSAT tool without the model.
    b. H_a: There is a significant difference in vendor/ department performance prediction capabilities between the WebSAT tool with the model and the WebSAT tool without the model.

Independent Variable for Prediction capability hypothesis: The independent variable is the decision support tool used in two levels: WebSAT with and without model.

Dependent Variable for Prediction capability hypothesis: The absolute difference of vendor performance predictions using WebSAT without the model from the model predicted probability was measured and compared.

2. Hypothesis for capability to understand the impact of various variables on performance levels (The Impact Experiment):
    a. H_0: There is no difference in the auditor's/ surveillance representative's capability to understand the impact of various variables on performance levels using the WebSAT tool with the model and the WebSAT tool without the model.
    b. H_a: There is a significant difference in the auditor's/ surveillance representative's capability to understand the impact of various variables on performance levels using the WebSAT tool with the model and WebSAT tool without the model.

Independent Variable for capability to understand impact of various variables on performance levels hypothesis: The independent variable is the decision support tool used to identify the sources for an audit's / surveillance's low/ high performance levels. It was tested at two levels: WebSAT with and without the model.

Dependent Variable for capability to understand impact of various variables on performance levels hypothesis: The absolute difference of vendor performance

predictions using WebSAT without the model from the model predicted probability was measured and compared.

Participants: In the Prediction Capability Experiment, seventeen employees from the surveillance and auditing groups of a major air transport company formed a representative sample of the aviation maintenance industry. There were five technical auditors, four internal auditors, and eight surveillance representatives. In the Impact Experiment, twenty three quality assurance personnel participated- seventeen auditors and surveillance representatives and five managers.

The participants were capable of using applications to analyze data obtained from aviation maintenance processes. Importantly, they are potential future users of WebSAT. After acquiring their consent to participate, the participants were tested on the tool at their work location.

The Planning Capability Experiment: Validation of the Model's Planning Capability

In addition to validating the model, its capability to enable audit and surveillance managers to plan their upcoming audits / surveillance events was evaluated. This was studied in a controlled experiment with prospective WebSAT users.

Planning Capability Hypothesis: The study tested the following hypothesis for capability to plan an audit or surveillance using the model:

H_0: There is no difference in an auditing / surveillance manager's capability to plan for an audit/ surveillance using the WebSAT tool with and without the model.

H_a: There is a significant difference in an auditing / surveillance manager's capability to plan for an audit/ surveillance using the WebSAT tool with the model and without the model.

Independent Variable for model's planning capability hypothesis: The independent variable is the decision support tool used to plan for an audit/ surveillance. This was tested at two levels: WebSAT with and without the model.

Dependent Variable for model's planning capability hypothesis: The dependent variable is the mean prediction ratings for all tasks for each participant using WebSAT with and without the model.

Participants: In this study, six quality assurance department managers- three from the auditing group and three from the surveillance work function of a major air transport company formed a representative sample of the aviation maintenance industry.

The participants were capable of using applications to analyze data obtained from aviation maintenance processes. Importantly, they are potential future users of WebSAT.

The Graphical Effectiveness Experiment: Validation of the Utility of the Graphical Displays in WebSAT's Model Review Section

The effectiveness of the graphical displays in the model review sections were studied in a controlled experiment with prospective WebSAT users.

Hypothesis: The study tested the following hypotheses:

H_0: There is no difference between the auditors', surveillance representatives' and managers' ability to understand the effect of predictor variables on vendor/ department performance with and without the graphical displays in the WebSAT tool's model review section.

H_a: There is a significant difference between auditors', surveillance representatives' and managers' ability to understand the effect of predictor variables on vendor/ department performance with and without the graphical displays in the WebSAT tool's model review section.

Independent Variable: The independent variable is the decision support tool used at two levels: WebSAT with graphical displays in the model review section and WebSAT without graphical displays in the model review section.

Dependent Variable: The mean accuracy rate with and without graphical displays in the model review section for all tasks for each participant was measured and compared. Thus the mean accuracy rate of all audit and surveillance tasks was the dependent variable.

Participants: Twenty three quality assurance personnel from a partnering airline participated in this study. There were five technical auditors, two technical audit managers, four internal auditors, one internal audit manager, eight surveillance representatives and three surveillance managers.

5.6 Apparatus and Settings

The study was conducted at the headquarters of a major air transport company in Memphis, Tennessee, and at aircraft maintenance vendor facilities in Greensboro, North Carolina and Mobile, Alabama. The study involved participants reviewing past audits and surveillance to predict vendor/ department performance. WebSAT was installed on a Dell Inspiron 700m laptop with Intel Pentium, 1.8 GHz, 512 MB RAM, 40 GB Hard Drive. A larger 19" Dell Ultra Sharp Flat Panel Dell Monitor was used to display WebSAT instead of the small laptop screen. The auditors and managers conducted the experiment in a cubicle in the airline office.

The surveillance representatives conducted the experiment in a conference room in their respective maintenance locations.

The study was conducted by loading WebSAT with a sample of the data used to generate the models. Due to limited technical capabilities of the WebSAT team and time available for WebSAT development, WebSAT does not have a data import capability. Thus, it was difficult to manually enter all of the data used to develop the models and hence only a sample of the data was manually entered into each WebSAT module. The sample was taken from the data that was used to generate the models. The Select Cases feature in the statistical software application SPSS was used to randomly select cases from the general population. More data was added to the randomly generated sample for completeness and for generation of audits and work orders which were of reasonable size. To ascertain that the tool contained sample data that was representative of the population, the frequency distribution, mean and standard deviation of the work function variables were obtained. See Appendices P, Q and R to review the sample distribution.

5.7 Procedure

The participants were asked for their consent to participate in the study prior to the start of the study (See Appendix S). The participants were introduced to WebSAT. They were informed that the goal of the study was to evaluate WebSAT's effectiveness in allowing them to predict vendor/ department performance and plan surveillance/audits. They were also informed that the results from the study and subsequent similar studies will be used to improve WebSAT's user interface. The participants were asked not to discuss their experiences with their colleagues who might be participating in the study, so as not to bias them. Multiple task scenarios

were presented to the participants who reviewed past audit and surveillance data using WebSAT to predict vendor/ department performance. The participants were informed that they could ask questions at anytime and were encouraged to verbalize their thoughts during the study.

5.8 Task

The task scenarios varied in an experiment depending on the participant type (auditor, representative or manager) and work function (Technical Audit or Internal Audit or Surveillance). They were chosen based on the different variables involved in the work function to give me the opportunity to understand the variation in the participant's predictions according to tasks. The tasks also exploited the different interactions identified in the model. The auditors and surveillance representatives were given the Prediction Capability, Impact and Graphical Effectiveness Experiments, while the managers were given the Planning Capability, Impact and Graphical Effectiveness Experiments - in that order. In the Prediction Capability Experiment, the task required the participant to make a prediction using the task description and data available in the task sheet and the historical sample data in WebSAT. In the Planning Capability Experiment, the managers were expected to choose a combination of variables that they predicted would result in low rejection rate for surveillance or high response rates for audits. In the Graphical Effectiveness Experiment, using a scale of high, low and same, the participant was asked to observe the graphs in the model review section of the prediction and planning tool to indicate if the response or rejection rate would be higher or lower or the same relative to a previous prediction made by the participant. Each participant took about an hour to complete the experiments. They were then asked to complete the SUMI

and feedback questionnaire to collect their subjective input on the prediction and planning tool. The experiments are described in the sections below.

5.8.1 Auditor and Surveillance Representative Experiment

The experiment was conducted on-site at airline management and maintenance locations. A repeated measure design was adopted. The experiment involved two tests. In both tests, the participants performed six audit/ surveillance activities. In test 2, after completion of the first six tasks, the participant completed the seventh task of interpreting the graphs. The order of the tests was kept the same for all participants to minimize learning from the model analysis. This experiment was conducted for all three work functions and is illustrated in Table XVIII.

Table XVIII. *Auditors' and Surveillance Representatives' Experiment*

	Test without model (Test 1)		**Test with model (Test 2)**
Participants	Quality assurance employees		Quality assurance employees
Tools used	WebSAT without model		WebSAT with model
Step 1	Tool introduction		Tool introduction
Step 2	Task description using task sheet		Task description using task sheet
Step 3	Read preliminary information	Each participant took both tests ⟺	Read preliminary information
Step 4	Historical data review		Historical data review
Step 5	Prediction Capability Experiment		Prediction Capability Experiment
Step 6	Impact Experiment		Impact Experiment
Step 7			Graphical Effectiveness Experiment

The two tests required the participants to read the task sheet for preliminary data on an audit or surveillance activity and its vendor/ department for each task. See Appendix T, U and V to view the task sheets. The tests required the participants to review the vendor's / department's history in WebSAT. Following this, in the test

without the model, participants were asked to predict a response rate (or a rejection rate for surveillance representatives) at the end of each task. In one of the tasks, each participant was given five sub-tasks and in each sub-task, the participant was to indicate the change in response or rejection rate for the different levels of each possible variable affecting vendor/ department performance. In the test with the model, the participants were to predict a response or rejection rate for the same tasks using the available model within the WebSAT tool. The coefficients of the variables in the model equation showed the degree to which the variables influence the response rates. For task 7 in test 2, the participants were asked to use the graphs in the model review section to indicate the change in the response or rejection rate.

Each participant using the tool with and without the model was asked to complete the SUMI questionnaire to rate their satisfaction with the Audit Impact and Surveillance Planning sections. The participant was also asked to complete a feedback questionnaire to collect the participant's subjective rating on the prediction and planning tool.

The mean response and rejection rates obtained using the WebSAT tool with and without the model for each participant were compared using a paired t test. The time taken to complete each task was also measured. For task 7, the choices made by the participants in interpreting the graphs were collected.

5.8.2 Auditor and Surveillance Manager Experiment

The experiment was conducted on-site at airline management and maintenance locations. A repeated measure design was adopted. The experiment involved two tests. The order of the tests was kept the same for all participants to minimize learning from the model analysis. This experiment was conducted for all three work functions and is illustrated in Table XIX.

Table XIX. *Managers' Experiment*

	Test without model (Test 1)		**Test with model (Test 2)**
Participants	Quality assurance managers		Quality assurance managers
Tools used	WebSAT without model		WebSAT with model
Step 1	Tool introduction		Tool introduction
Step 2	Task description using task sheet		Task description using task sheet
Step 3	Read preliminary information	Each participant took both tests ⟺	Read preliminary information
Step 4	Historical data review		Historical data review
Step 5	Planning Capability Experiment		Planning Capability Experiment
Step 6	Impact Experiment		Impact Experiment
Step 7			Graphical Effectiveness Experiment

In both the tests, the participants had access to data on an audit/ a surveillance activity and its vendor/ department for each task. This information was provided using the WebSAT tool. The participants were provided with a description of the test on a task sheet. See Appendix W, X and Y to view the task sheets. Each participant was asked to complete six tasks in the test without the model and seven tasks in the test with the model. In the test without the model, the participants

reviewed an audit/ surveillance event for a vendor/ department employing the WebSAT tool. They were asked to make an allocation based on the current information available. For each task, a participant was asked to choose a particular combination of variables from the task sheet which would give a low rejection rate or a high response rate.

In the test with the model, the participants performed the same tasks as in the test without the model. In this test, when they selected the variable values from the drop down in the Audit Allocation or Surveillance Planning sections of WebSAT, a predicted response or rejection rate was shown. Thus, the participants in the test with the model were able to observe the change in response or rejection rate for selections made. For task 7, the participants were asked to use the graphs in the model review section to indicate the change in the response or rejection rate.

Each participant was asked to complete the SUMI questionnaire to rate their satisfaction with the Audit Allocation or Surveillance Planning tools. The participant was also asked to complete a feedback questionnaire to collect the participant's input on the prediction and planning tools. The mean response and rejection rates obtained using the WebSAT tool with and without the model for each participant were compared using a paired T test. The time taken to complete each task was also measured. The combinations identified by the managers in the Planning Capability Experiment were also collected and compared to the model predictions. For task 7, the choices made by the participants in interpreting the graphs were collected.

CHAPTER VI: EXPERIMENT RESULTS

This chapter presents the results of the experiments described in Chapter V. It also includes the revised screens of the Audit Impact, Audit Allocation and Surveillance Planning tools in iteration 2 using the feedback collected from the participants in the study.

6.1 Auditor and Surveillance Representative Experiments

The results of the experiments conducted on the three WebSAT modules are presented below. The Audit Impact section in the Technical Audit module was used by the technical auditors; the Audit Impact section in the Internal Audit Module was used by the internal auditors; and the Surveillance Planning section was used by the surveillance representatives for this experiment.

6.1.1 Results for Technical Audit Module experiment using Audit Impact section

The mean response rates in the Technical Audit module Prediction Capability and Impact Experiments for each participant are presented in Table XX. The mean response rate for all participants was 92.76 in the Prediction Capability Experiment and 84.92 in the Impact Experiment when the model was not available. The average absolute difference was used to compute the paired t-test analysis. The paired t-test results were significant with $p = 0.038$ for the Impact Experiment (See Table XXI). Considering the near significance of the results for the Prediction Capability Experiment, a larger sample size might reveal significance. A single value is shown for Test 2 in the Table XX, since the same outcome was predicted by the model for all participants.

Table XX. *Technical Audit Prediction Capability and Impact Experiment Results*

Technical Audit Response Rate				
	Prediction		Impact	
Participant	Test1	Test2	Test1	Test2
1	90.2		84.2	
2	88.4		80	
3	98.2	88.97	84.6	88.25
4	92		86.4	
5	95		89.4	
MEAN	92.76	88.97	84.92	88.25

Table XXI. *Technical Audit Prediction Capability and Impact Experiment Results - Paired Samples Test for response rates*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Prediction	Test1 - Test2	4.018	3.600	1.610	-.452	8.488	2.495	4	.067
Impact	Test1 - Test2	3.790	2.770	1.239	.349	7.230	3.058	4	.038

The mean time taken to complete the Prediction Capability and Impact Experiments by each participant is presented in Table XXII. The mean time taken for all participants was 2.74 minutes and 1.14 minutes in Test 1 and Test 2, respectively, for the Prediction Capability Experiment. The mean time taken for all participants was 2.17 minutes and 0.81 minutes in Test 1 and Test 2, respectively, for the Impact Experiment. The paired t-test results were significant with $p = 0.049$ and 0.045 for the Prediction Capability and Impact Experiments respectively (See Table XXIII). The mean time taken to complete the Graphical Effectiveness Experiment was 0.59 minutes. The auditors were able to use and interpret the graphs in the Audit

Impact tool to indicate the direction of change of the response rate for the tasks provided in the task sheet (See Table XXIV). A "1" indicates that the choice made by the participant for the task in the experiment matched the model result.

Table XXII. *Technical Audit Prediction Capability and Impact Experiment Time Results*

Technical Audit Time (Minutes)				
	Prediction		Impact	
Participant	Test1	Test2	Test1	Test2
1	4.8	1.11	3.2	0.8
2	2.6	1.13	3	0.78
3	1.72	1.07	1.2	0.67
4	2.89	1.24	2.57	0.9
5	1.72	1.19	0.89	0.9
MEAN	2.74	1.14	2.17	0.81

Table XXIII. *Technical Audit Prediction Capability and Impact Experiment Results- Paired Samples Test for time*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Prediction	Test1 - Test2	1.594	1.272	0.568	0.014	3.173	2.802	4	0.049
Impact	Test1 - Test2	1.362	1.058	0.473	0.047	2.676	2.877	4	0.045

Table XXIV. *Technical Audit Graphical Effectiveness Experiment Results*

		Participant				
Task	Model Response	1	2	3	4	5
1	Higher	1	1	1	1	1
2	Same	1	1	1	1	1
3	Same	1	1	1	1	1
4	Same	1	1	1	1	1
5	Lower	1	1	1	1	1

6.1.2 Results for Internal Audit Module experiment using Audit Impact section

The mean response rates in the Internal Audit module Prediction Capability and Impact Experiments for each participant are presented in Table XXV. The mean response rate for all participants was 82.9 in the Prediction Capability Experiment and 86.06 in the Impact Experiment when the model was not available. The average absolute difference was used to compute the paired t-test analysis. The paired t-test results was significant with $p = 0.001$ for the Impact Experiment (See Table XXVI). Considering the near significant result of the Prediction Capability Experiment, a larger sample size may reveal significance. A single value is shown for Test 2 in the Table XXV, since the same outcome was predicted by the model for all participants.

Table XXV. *Internal Audit Prediction Capability and Impact Experiment Result*

Internal Audit Response Rate				
	Prediction		Impact	
Participant	Test1	Test2	Test1	Test2
1	75.6	89.13	72.5	87.11
2	88		98.5	
3	84		97	
4	84		76.25	
MEAN	82.9	89.13	86.06	87.11

Table XXVI. *Internal Audit Prediction Capability and Impact Experiment Results- Paired Samples Test for response rates*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Prediction	Test1 - Test2	6.230	5.219	2.609	-2.074	14.534	2.387	3	.097
Impact	Test1 - Test2	11.687	2.044	1.022	8.433	14.941	11.431	3	.001

The mean time taken to complete the Prediction Capability and Impact Experiments by each participant is presented in Table XXVII. The mean time taken for all participants was 2.52 minutes and 0.75 minutes in Test 1 and Test 2, respectively, for the Prediction Capability Experiment. The mean time taken for all participants was 1.01 minutes and 0.53 minutes in Test 1 and Test 2, respectively, for the Impact Experiment. The paired t-test result was significant with $p = 0.05$ for the Prediction Capability Experiment (See Table XXVIII). However, the Impact Experiment paired t-test result was not significant. The mean time taken to complete the Graphical Effectiveness Experiment was 0.26 minutes. The auditors were able to use and interpret the graph in the Audit Impact tool to indicate the direction of change of the response rate for the tasks provided in the task sheet (See Table XXIX). A "1" indicates that the choice made by the participant for the task in the experiment matched the model result.

Table XXVII. *Internal Audit Prediction Capability and Impact Experiment Time Results*

Internal Audit Time (Minutes)				
	Prediction		Impact	
Participant	Test1	Test2	Test1	Test2
1	3.2	0.8	0.85	0.75
2	1.6	0.76	0.9125	0.3875
3	3.67	0.64	1.345	0.325
4	1.63	0.8	0.95	0.675
MEAN	2.52	0.75	1.01	0.53

Table XXVIII. *Internal Audit Prediction Capability and Impact Experiment Results- Paired Samples Test for time*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Prediction	Test1 - Test2	1.775	1.115	0.557	0.00002	3.549	3.182	3	0.050
Impact	Test1 - Test2	0.480	0.400	0.200	-0.156	1.116	2.400	3	0.096

Table XXIX. *Internal Audit Graphical Effectiveness Experiment Results*

		Participant			
Task	Model Response	1	2	3	4
1	Same	1	1	1	1
2	Higher	1	1	1	1
3	Lower	1	1	1	1
4	Higher	1	1	1	1

6.1.3 Results for Surveillance Module experiment using Surveillance Planning section

The mean rejection rates in the Surveillance module Prediction Capability and Impact Experiments for each participant are presented in Table XXX. The mean rejection rate for all participants was 7.25 in the Prediction Capability Experiment

and 7.775 in the Impact Experiment when the model was not available. The average absolute difference was used to compute the paired t-test analysis. The paired t-test results were significant, with $p = 0.013$ and $p = 0.003$ for the Prediction Capability and Impact Experiments (See Table XXXI). A single value is shown for Test 2 in the Table XXX, since the same outcome was predicted by the model for all participants.

Table XXX. *Surveillance Experiment Prediction Capability and Impact Results*

Surveillance Rejection Rate				
	Prediction		Impact	
Participant	Test1	Test2	Test1	Test2
1	6.4	4.4	9.4	10.6
2	9.4		7.6	
3	6.6		9.8	
4	5.4		4.4	
5	6.4		6.8	
6	12.4		13.8	
7	6.4		3	
8	5		7.4	
Mean	7.25	4.4	7.77	10.6

Table XXXI. *Surveillance Prediction Capability and Impact Experiment Results- Paired Samples Test for rejection rates*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Prediction	Test1 - Test2	2.850	2.455	.868	.796	4.903	3.282	7	.013
Impact	Test1 - Test2	3.625	2.301	.813	1.700	5.549	4.455	7	.003

The mean time taken to complete the Prediction Capability and Impact Experiments by each participant is presented in Table XXXII. The mean time taken

for all participants was 4.07 minutes and 2.00 minutes in Test 1 and Test 2, respectively, for the Prediction Capability Experiment. The mean time taken for all participants was 0.95 minutes and 0.89 minutes in Test 1 and Test 2, respectively, for the Impact Experiment. The paired t-test result was significant with $p = 0.004$ for the Prediction Capability Experiment (See Table XXXIII). However, the Impact Experiment paired t-test result was not significant. The mean time taken to complete the Graphical Effectiveness Experiment was 0.81 minutes. The surveillance representatives were able to use and interpret the graphs in the Surveillance Planning tool to indicate the direction of change of the rejection rate for the tasks provided in the task sheet (See Table XXXIV). A "1" indicates that the choice made by the participant for the task in the experiment matched the model result.

Table XXXII. *Surveillance Prediction Capability and Impact Experiment Time Results*

Surveillance Time (Minutes)				
	Prediction		Impact	
Participant	Test1	Test2	Test1	Test2
1	5.94	1.46	1.65	1.13
2	4.25	1.392	1.74	1.109
3	4.88	3.14	0.78	0.95
4	4.08	1.44	1.06	0.79
5	4.18	1.67	0.82	0.77
6	3.34	3.34	0.63	0.89
7	3.38	1.76	0.39	0.78
8	2.52	1.83	0.53	0.71
MEAN	4.07	2.00	0.95	0.89

Table XXXIII. *Surveillance Prediction Capability and Impact Experiment Results- Paired Samples Test for time*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Prediction	Test1 - Test2	2.067	1.386	0.490	0.908	3.226	4.218	7	0.004
Impact	Test1 - Test2	0.058	0.377	0.133	-0.256	0.374	0.441	7	0.672

Table XXXIV. *Surveillance Graphical Effectiveness Experiment Results*

		Participants							
Task	Model Response	1	2	3	4	5	6	7	8
1	Same	1	1	1	1	1	1	1	1
2	Higher	1	1	1	1	1	1	1	1
3	Same	1	1	1	1	1	1	1	1
4	Lower	1	1	1	1	1	1	1	1
5	Higher	1	1	1	1	1	1	1	1

6.2 Audit and Surveillance Manager Experiments

The results of the experiments with the managers conducted on the three WebSAT modules are presented below. The Audit Allocation sections of the Technical and Internal Audit modules were used by the technical and internal audit managers, respectively. The Surveillance Planning section was used by the surveillance managers for this experiment.

6.2.1 Results for Technical Audit Module experiment using Audit Allocation section

The mean response rates on the Technical Audit module in the Planning Capability and Impact Experiments for each participant are presented in Table XXXV. The mean response rate was 88.8 in the Planning Capability Experiment and 89.6 in the Impact Experiment when the model was not available. The average

absolute difference was used to compute the paired t-test analysis. The paired t-test results were not significant with $p = 0.07$ and 0.183 for the Planning Capability and Impact Experiments, respectively (See Table XXXVI). Considering the near significant result for the Planning Capability Experiment, a larger sample size might reveal significance. A single value is shown for Test 2 in the Table XXXV, since the same outcome was predicted by the model for the two participants.

Table XXXV. *Technical Audit Planning Capability and Impact Experiment Results*

Technical Audit Response Rate				
	Planning		Impact	
Participant	Test1	Test2	Test1	Test2
1	89.8	97.85	90	88.25
2	87.8		89.2	
MEAN	88.8	97.85	89.6	88.25

Table XXXVI. *Technical Audit Planning Capability and Impact Experiment Results- Paired Samples Test for response rates*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Planning	Test1 - Test2	9.050	1.414	1.000	-3.656	21.756	9.050	1	.070
Impact	Test1 - Test2	1.350	.565	.400	-3.732	6.432	3.375	1	.183

The mean time taken to complete the Planning Capability and Impact Experiments by each participant is presented in Table XXXVII. The mean time taken for the two managers was 3.3 minutes and 1.2 minutes in Test 1 and Test 2, respectively, for the Planning Capability Experiment. The mean time taken for the two managers was 2.18 minutes and 0.78 minutes in Test 1 and Test 2 respectively in

the Impact Experiment. The paired t-test result was significant with $p = 0.021$ for the Planning Capability Experiment (See Table XXXVIII). The paired t-test result was not significant for the Impact Experiment. The mean time taken to complete the Graphical Effectiveness Experiment was 0.52 minutes. The managers were able to use and interpret the graphs in the Audit Allocation tool to indicate the direction of change of the response rate for the task provided in the task sheet (See Table XXXIX). A "1" indicates that the choice made by the participant for the task in the experiment matched the model result.

Table XXXVII. *Technical Audit Planning Capability and Impact Experiment Time Results*

Technical Audit Time (Minutes)				
	Planning		Impact	
Participant	Test1	Test2	Test1	Test2
1	3.4	1.23	2.4	0.81
2	3.2	1.17	1.96	0.75
MEAN	3.3	1.2	2.18	0.78

Table XXXVIII. *Technical Audit Planning Capability and Impact Experiment Results- Paired Samples Test for time*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Planning	Test1 - Test2	2.100	0.098	0.070	1.210	2.989	30.000	1	0.021
Impact	Test1 - Test2	1.400	0.268	0.190	-1.014	3.814	7.368	1	0.086

Table XXXIX. *Technical Audit Graphical Effectiveness Experiment Results-(Manager)*

		Participant	
Task	Model Response	1	2
1	Higher	1	1
2	Same	1	1
3	Same	1	1
4	Same	1	1
5	Lower	1	1

In the Planning Capability Experiment, the managers were also asked to choose an allocation combination that produced a high response rate. The choices made by the managers are presented in Table XL. A "1" indicates that the choice made by the participant for the task in the experiment matched the model result.

Table XL. *Technical Audit Experiment Combination Results*

		Participant	
Task	Model Response	1	2
1	AAA	1	1
2	BAA	1	1
3	ACA	1	1
4	AAA	1	1
5	BBA	1	1

6.2.2 Results for Internal Audit Module experiment using Audit Allocation section

The response rates on the Internal Audit module Planning Capability and Impact Experiment for one manager are presented in Table XLI. The response rate was 91.8 in the Planning Capability Experiment and 91 in the Impact Experiment when the model was not available. Because only one individual was tested, no paired t-test analysis could be conducted.

Table XLI. *Internal Audit Planning Capability and Impact Experiment Results*

Internal Audit Response Rate				
	Planning		Impact	
Participant	Test1	Test2	Test1	Test2
1	91.8	89.13	91	87.12
MEAN	91.8	89.13	91	87.12

The mean time taken to complete the Planning Capability and Impact Experiments is presented in Table XLII. The mean time taken was 3 minutes and 0.55 minutes in Test 1 and Test 2, respectively, for the Planning Capability Experiment. The mean time taken was 0.93 minutes and 0.86 minutes in Test 1 and Test 2, respectively, for the Impact Experiment. The mean time taken to complete the Graphical Effectiveness Experiment was 0.47 minutes. The manager was able to use and interpret the graph in the Audit Allocation tool to indicate the direction of change of the response rate for the task provided in the task sheet (See Table XLIII). A "1" indicates that the choice made by the participant for the task in the experiment matched the model result.

Table XLII. *Internal Audit Planning Capability and Impact Experiment Time Results*

Internal Audit Time (Minutes)				
	Planning		Impact	
Participant	Test1	Test2	Test1	Test2
1	3	0.55	0.93	0.86
MEAN	3	0.55	0.93	0.86

Table XLIII. *Internal Audit Graphical Effectiveness Experiment Results- (Manager)*

		Participant
Task	Model Response	1
1	Same	1
2	Higher	1
3	Lower	1
4	Higher	1

In the Planning Capability Experiment, the manager was also asked to choose an allocation combination that produced a high response rate. The choices made by the manager are presented in Table XLIV. A "1" indicates that the choice made by the participant for the task in the experiment matched the model result. A "0" indicates that the choice made by the participant for the task in the experiment did not match the model result.

Table XLIV. *Internal Audit Experiment Combination Results*

		Participant
Task	Model Response	1
1	AAA	1
2	ABA	1
3	AAA	0
4	AAA	1
5	AAA	1

6.2.3 Results for Surveillance Module experiment using Surveillance Planning section

The mean rejection rates on the Surveillance module in the Planning Capability and Impact Experiment for each participant are presented in Table XLV. The mean rejection rate for all participants was 9.73 in the Planning Capability Experiment and 10.06 in the Impact Experiment when the model is not available. The average absolute difference was used to compute the paired t-test analysis. The

paired t-test results were not significant for both the experiments (See Table XLVI). A single value is shown in the Test 2 in the Table XLV, since the same single outcome was predicted by the model for all participants.

Table XLV. *Surveillance Experiment Planning Capability and Impact Results*

Surveillance Rejection Rate				
	Planning		Impact	
Participant	Test1	Test2	Test1	Test2
1	10.6	8.4	13.4	10.6
2	10.2		5.8	
3	8.4		11	
MEAN	9.73	8.4	10.06	10.6

Table XLVI. *Surveillance Planning Capability and Impact Experiment Results- Paired Samples Test for rejection rates*

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Planning Test1 - Test2	1.333	1.171	.676	-1.577	4.244	1.971	2	.188
Impact Test1 - Test2	2.666	2.203	1.271	-2.805	8.139	2.097	2	.171

The mean time taken to complete the Planning Capability and Impact is presented in Table XLVII. The mean time was 5.35 minutes and 1.45 minutes in Test 1 and Test 2, respectively, for the Planning Capability Experiment. The mean time was 1.61 minutes and 1.06 minutes in Test 1 and Test 2, respectively, for the Impact Experiment. The paired t-test result was significant with $p = 0.011$ for the Planning Capability Experiment (See Table XLVIII). The Impact Experiment paired t-test result was not significant. The mean time taken to complete the Graphical

Effectiveness Experiment was 0.29 minutes. With the exception of one response, the surveillance managers were able to use and interpret the graphs in the Surveillance Planning tool to indicate the direction of change of the rejection rate for the task provided in the task sheet (See Table XLIX). A "1" indicates that the choice made by the participant for the task in the experiment matched the model result. A "0" indicates that the choice made by the participant for the task in the experiment did not match the model result.

Table XLVII. *Surveillance Planning Capability and Impact Experiment Time Results*

Surveillance Time (Minutes)				
	Planning		Impact	
Participant	Test1	Test2	Test1	Test2
1	5.4	1.93333	2.5	1
2	6	1.26667	0.83333	1.25
3	4.66667	1.15	1.5	0.93333
MEAN	5.35	1.45	1.61	1.06

Table XLVIII. *Surveillance Planning Capability and Impact Experiment Results- Paired Samples Test for time*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Planning	Test1 - Test2	3.905	0.717	0.414	2.123	5.687	9.431	2	0.011
Impact	Test1 - Test2	0.550	0.958	0.553	-1.830	2.930	0.994	2	0.425

Table XLIX. *Surveillance Graphical Effectiveness Experiment Results- (Manager)*

		Participants		
Task	Model Response	1	2	3
1	Same	1	1	1
2	Higher	1	1	1
3	Same	1	0	1
4	Lower	1	1	1
5	Higher	1	1	1

In the Planning Capability Experiment, the managers were also asked to choose a combination that produced a high response rate. The combination choices made by the managers are presented in Table L.

Table L. *Surveillance Experiment Combination Results*

		Participant		
Task	Model Response	1	2	3
1	AAA	1	1	1
2	BAA	1	1	1
3	AAA	1	1	1
4	AAA	1	1	1
5	AAB	1	1	1

6.3 Software Usability Measurement Inventory Analysis

Subsequent to the tasks assigned in the task sheet, each participant completed the standard Software Usability Measurement Inventory Analysis (SUMI) questionnaire, to collect data on user satisfaction. The 50 questions in this questionnaire are answered as agree, undecided, disagree, represented by a 1, 2 and 3, respectively. The subsequent analysis measures the product on five specific scales – Efficiency, Affect, Helpfulness, Control and Learnability – in addition to a sixth, the Global Usability scale, which is a general satisfaction measure. These scales measure the degree to which the participant can meet the demands of the tasks or the

computer system, given his/ her ability and level of knowledge. The higher the SUMI score, the better the product is. A good product will achieve scores of 50 and above. Scores below 40 indicate the need for remedial action. As seen in Table LI, the scores achieved higher than 50 on all six scales on all modules. See Appendix Z for details.

Table LI. *Summarized SUMI Scores*

	Median SUMI Scores					
	Technical Auditor		Internal Auditor		Surveillance	
Scale	Auditor	Manager	Auditor	Manager	Representative	Manager
Global	73	62	63	64	70	63
Efficiency	68	61	57	64	65	64
Affect	71	59	59	59	60	59
Helpfulness	71	61	61	65	67	61
Control	71	56	65	65	69	57
Learnability	71	60	62	68	68	62

The Table LII shows the mean ratings from all participants for each criterion from the Feedback questionnaire. The questionnaire has six criteria which were rated by each participant on a scale of 1 to 7 where 7 indicates system satisfied the criterion completely and 1 indicates system barely satisfied the criterion. The mean ratings are higher for WebSAT with model than without the model. See Appendix AA for details. Table LIII indicates the significance results from the paired t test analysis for the feedback questionnaire subjective ratings with and without the model for each criterion. The results show that there was significant difference in the ratings for the criteria of (a) Ability to predict response / rejection rates, (b) Ability to assess risk factors and their impact, and (c) Ability to view historical information graphically. The ratings were not significantly different for the other criteria.

Table LII. *Summarized Feedback Questionnaire Ratings*

Criteria	WebSAT without Model	WebSAT with Model
Easy retrieval of audit information (C1)	4.57	4.65
Availability of important audit information (C2)	4.43	4.48
Reduction of non-value-added activities during audit information review(C3)	4.70	4.78
Ability to predict response / rejection rates (C4)	3.09	4.65
Ability to assess risk factors and their impact (C5)	3.48	4.65
Ability to view historical information graphically (C6)	3.61	4.61
MEAN	3.98	4.64

Table LIII. *Significance results for Feedback Questionnaire ratings*

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
WithoutC1 - WithC1	-0.09	0.29	0.06	-0.21	0.04	-1.45	22.00	0.16
WithoutC2 - WithC2	-0.04	0.21	0.04	-0.13	0.05	-1.00	22.00	0.33
WithoutC3 - WithC3	-0.09	0.42	0.09	-0.27	0.09	-1.00	22.00	0.33
WithoutC4 - WithC4	-1.57	0.95	0.20	-1.97	-1.16	-7.94	22.00	0.00
WithoutC5 - WithC5	-1.17	1.03	0.21	-1.62	-0.73	-5.47	22.00	0.00
WithoutC6 - WithC6	-1.00	0.90	0.19	-1.39	-0.61	-5.30	22.00	0.00

6.4 Target Specifications

The target specifications collected during the experiment are presented in Table LIV. The values for Metric # 1 and 3 are the mean time taken by the participants to conduct the Impact Experiment. The value for Metric 2 is the mean time taken by the participants to conduct the Prediction and Planning Capability

Experiments (See Appendix AA). The value for Metric 4 is the mean subjective rating from the feedback questionnaire on a scale of 1 to 7 where 7 indicates system satisfied the criterion completely and 1 indicates system barely satisfied the criterion (See Appendix AA).

Table LIV. *Target Specifications*

Metric #	Need Numbers	Metric	Units	Value WebSAT without model	Value WebSAT with model
1	2, 4, 6	Time taken to generate useful information for future maintenance and audits.	minutes	1.42	0.82
2	2, 3, 6, 7	Time taken to analyze vendor/ department performance	minutes	3.57	1.39
3	1, 3, 5, 6	Time to identify risk factors.	minutes	1.42	0.82
4	2, 4, 6	Ability to generate useful information for future maintenance and audits.	Subj.	3.98	4.64

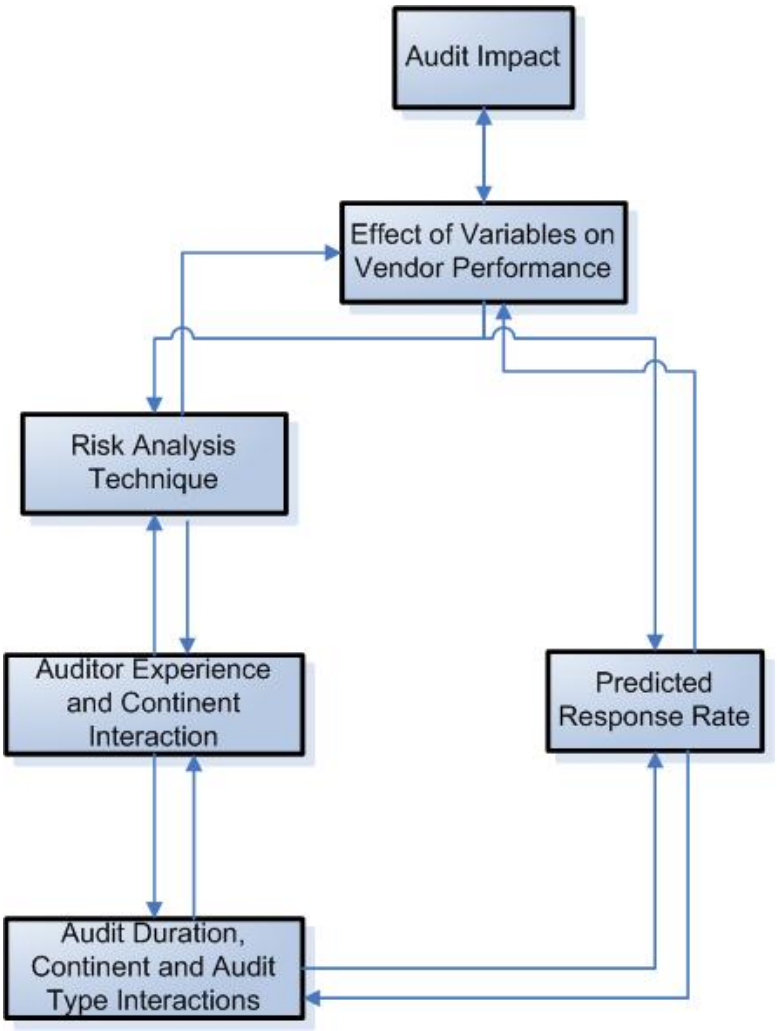
6.5 Screen Designs (Iteration 2)

The revised screens following the feedback received from the participants during the experiments are presented in this section. In general, the screens in the Audit Impact, Audit Allocation and Surveillance Planning sections continue to follow a similar pattern of (a) data specification, where the user would enter data specifying values for the model variables; (b) model review, where the user reviewed the model and the different graphical interactions; and (c) model results, where the user viewed the model's predicted rejection or response rate.

6.5.1 Technical Audit Module Screens- Audit Impact

The revised product map for the Technical Audit module's Audit Impact screens is shown in Figure LVI. The revision involved combining the Technical Audit Model Details page, the Risk Analysis Technique and Research page and the Understanding Variable Interaction page into a single page. The participants considered these pages to be "one time use only" pages.

Figure LVI. *Audit Impact Product Map*



The details on the screens in the Audit Impact section have been presented in Chapter V. This section illustrates the screens for which revisions were made to the Audit Impact tool. The revisions to the Audit Impact section screens include:

1) Addition of a description box which presents the different parameters chosen in the Audit Impact page.
2) Addition of Previous and Next buttons at the top and bottom of all pages (except for the Audit Impact, Effect of Variables on Vendor Performance and Predicted Response Rate pages) to allow users to reduce the time taken to look for the buttons and navigate through the section.
3) Addition of Model Details, Variable Interactions and Back to Top anchor links to the Risk Analysis Technique and Research page.
4) Setting the default value for the radio button in the Effect of Variables on Vendor Performance page to "Yes."

The revised screens are shown in the figures below.

Figure LVII. *Effect of Variables on Vendor Performance*

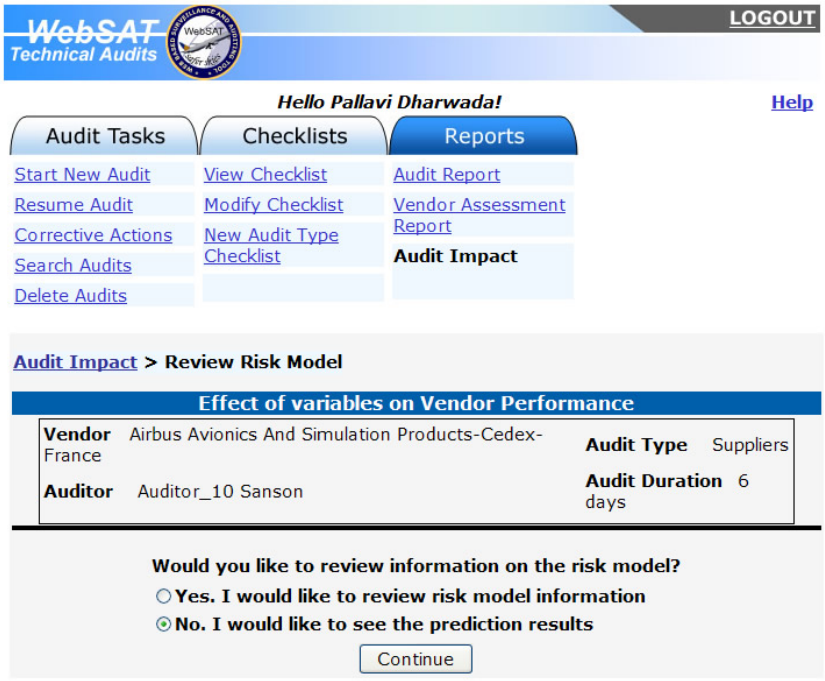


Figure LVIII. *Risk Analysis Technique and Research*

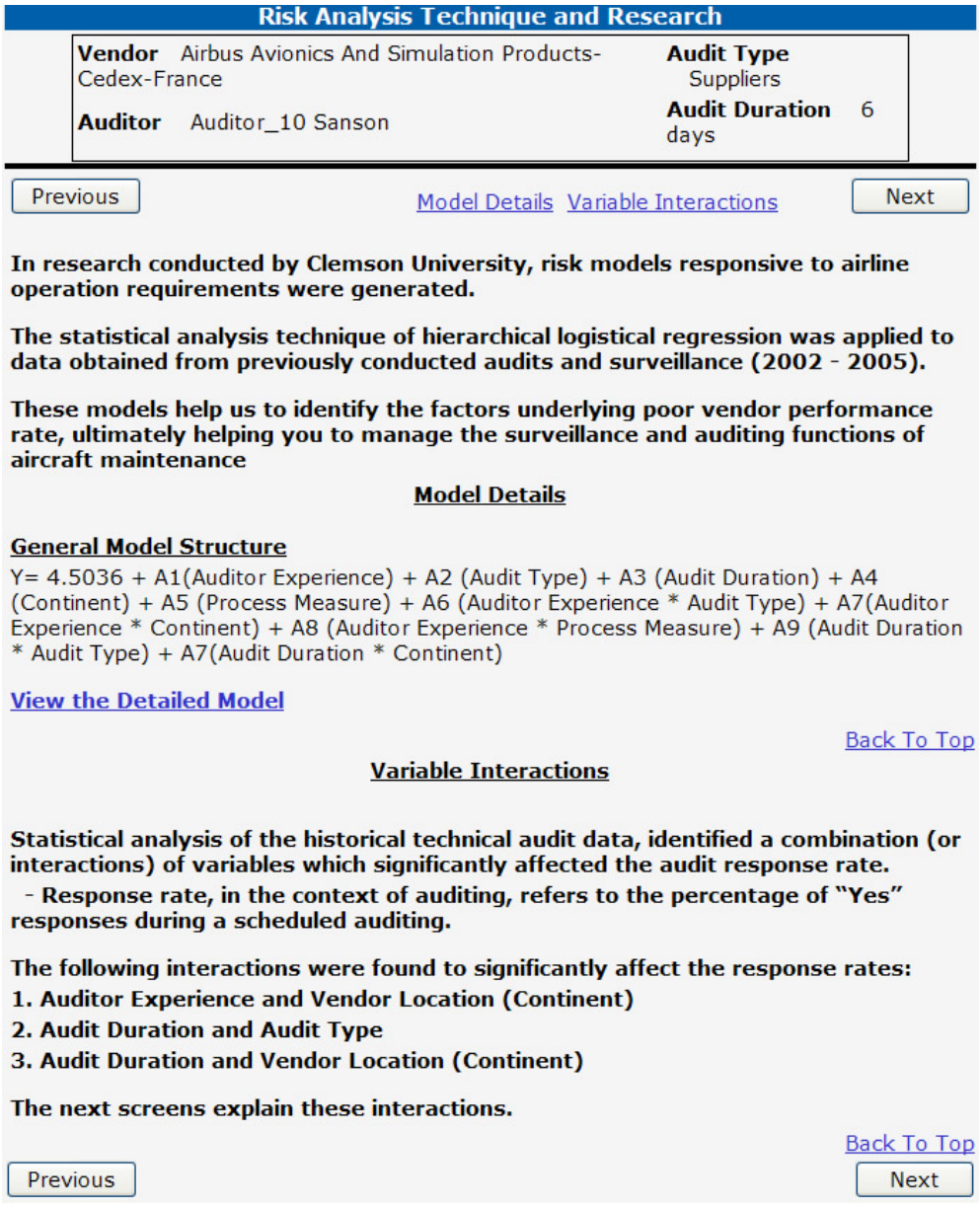


Figure LIX. *Auditor Experience and Continent Interactions*

Auditor Experience and Continent Interactions-Graphs

Vendor Airbus Avionics And Simulation Products-Cedex-France

Audit Type Suppliers

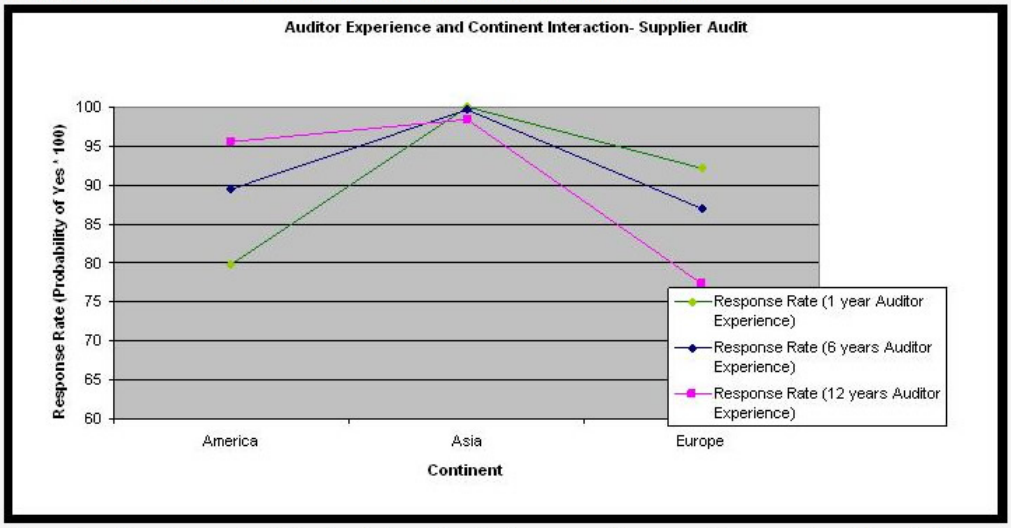
Auditor Auditor_10 Sanson

Audit Duration 6 days

Previous Next

Show All

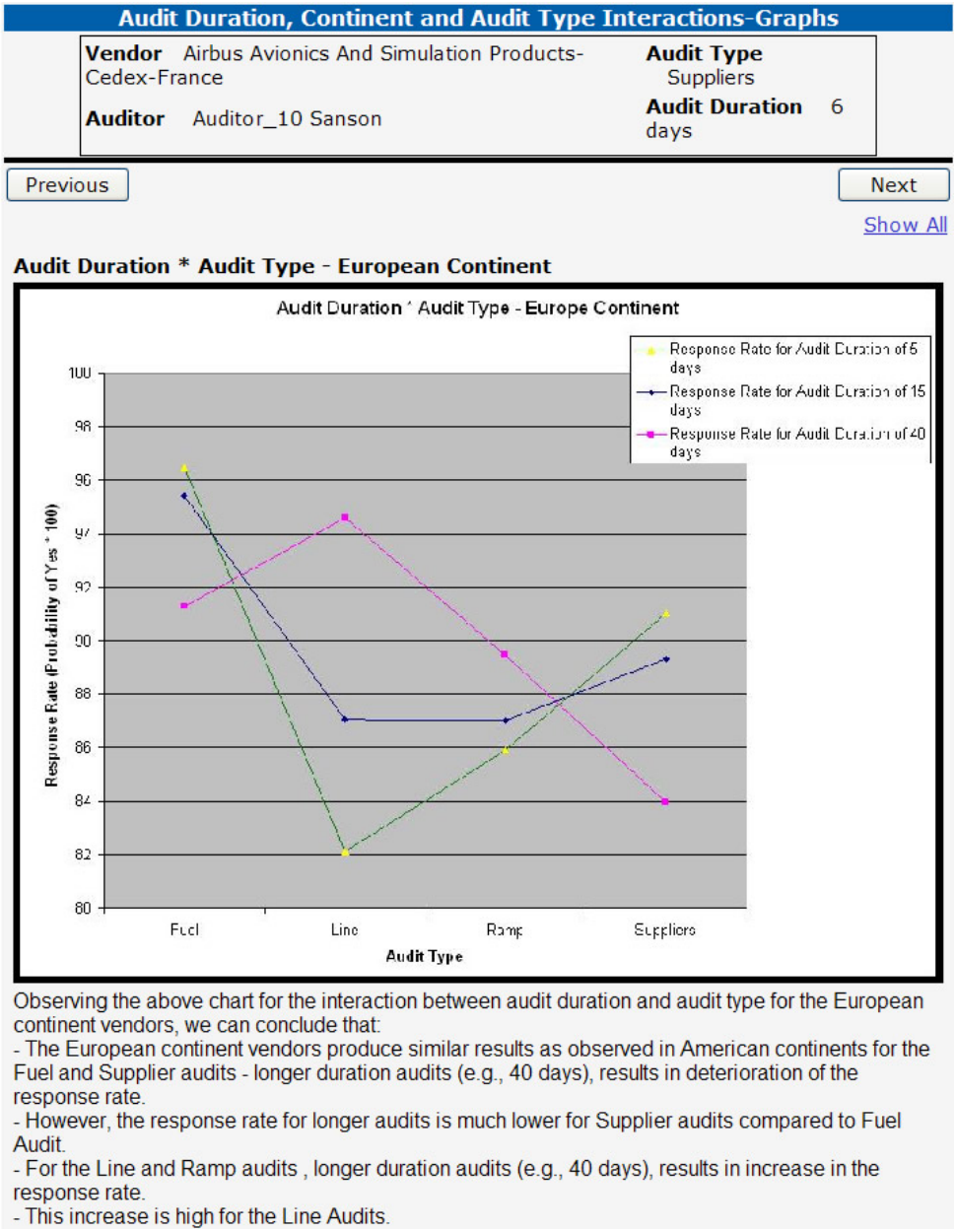
Auditor Experience and Continent Interaction - Supplier Audit



Observing the above chart for the interaction between auditor experience and continent of supplier audits, we can conclude that:
- For the vendors located on the American continent, an increase in auditor experience, resulted in a small increase in response rate.
- The European and Asian continent vendors produce an opposite relationship, where an increase in auditor experience, resulted in an decrease in response rate.
- The European continent vendors showed a decrease in the response rate for higher auditor experience.
- For the Asian continent vendors, the response rates were high for all auditor experiences and audit types.

Previous Next

Figure LX. *Audit Duration, Continent and Audit Type Interactions*



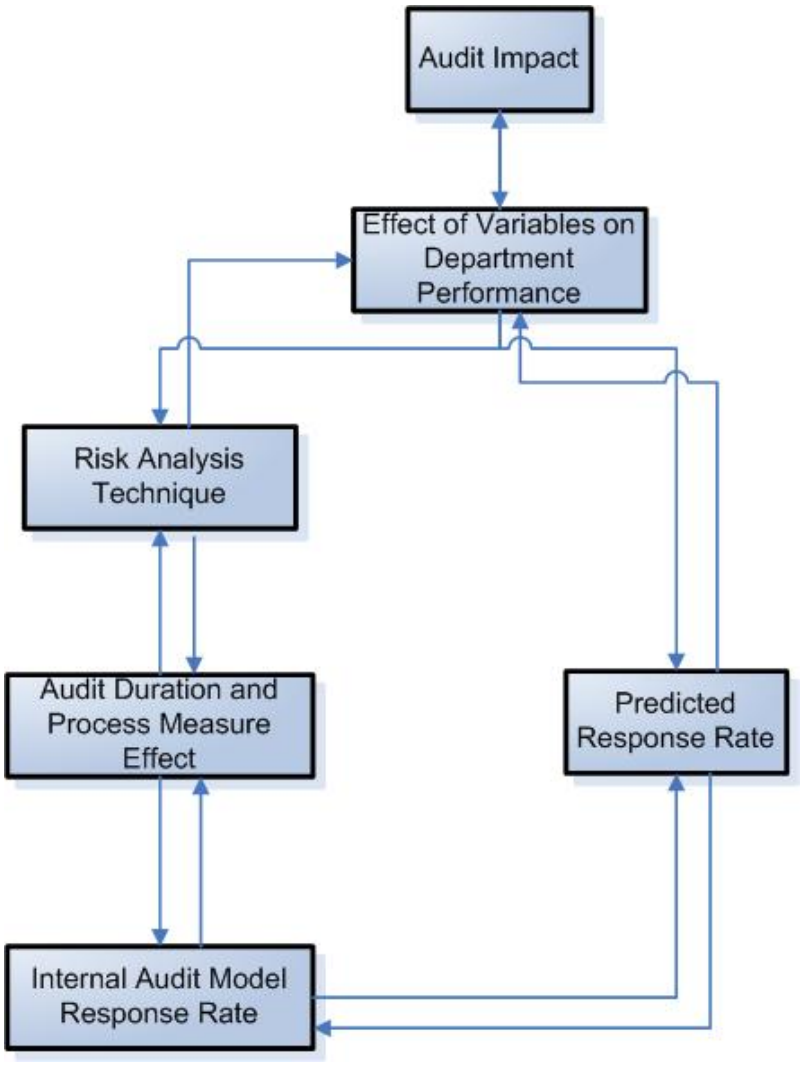
6.5.2 Technical Audit Module Screens- Audit Allocation

The details on the screens in the Audit Allocation tool have been presented in Chapter V. The revisions made to the Audit Allocation tool screens are identical to those made to the Audit Impact tool screens. No changes were made to the Audit Allocation page.

6.5.3 Internal Audit Module Screens- Audit Impact

The revised product map for the Internal Audit module's Audit Impact screens is shown in Figure LXI. Like the Technical Audit module, the revision involved combining the Internal Audit Model Details page, the Risk Analysis Technique and Research page and the Understanding Variable Interaction page into a single page. The participants considered these pages to be "one time use only" pages.

Figure LXI. *Audit Impact Product Map*



The details on the screens in the Audit Impact tool have been presented in Chapter V. This section illustrates the revisions made to the Audit Impact tool screens. The revisions made to the Internal Audit module's Audit Impact screens are identical to those made to the Technical Audit module's Audit Impact tool screens. The revised screens are shown in the figures below.

Figure LXII. *Effect of Variables on Department Performance*

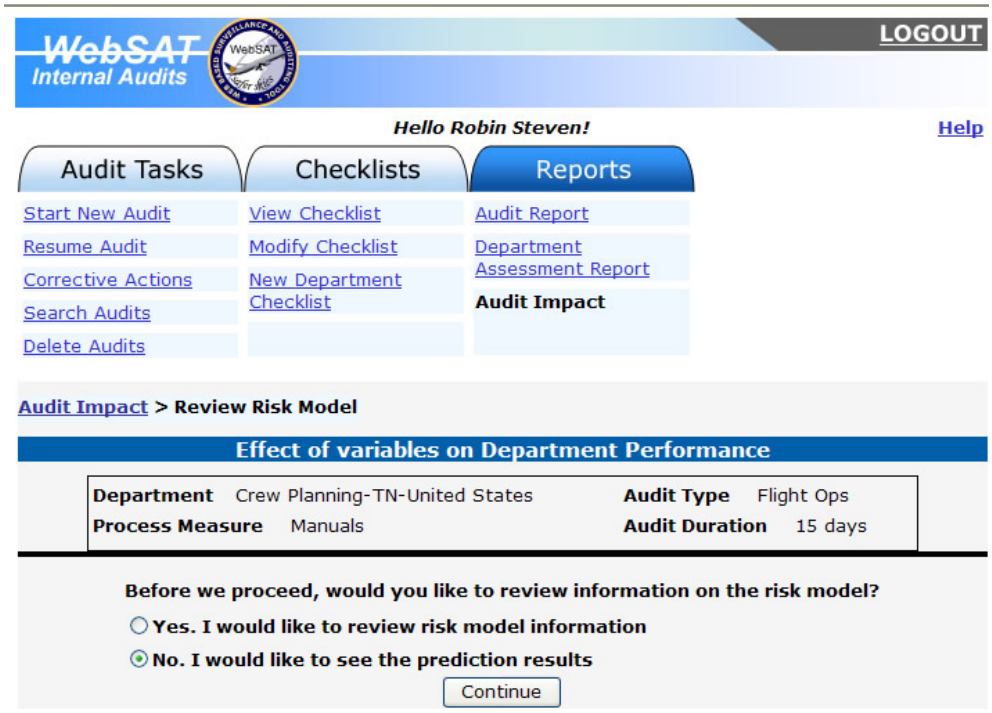


Figure LXIII. *Risk Analysis Technique and Research*

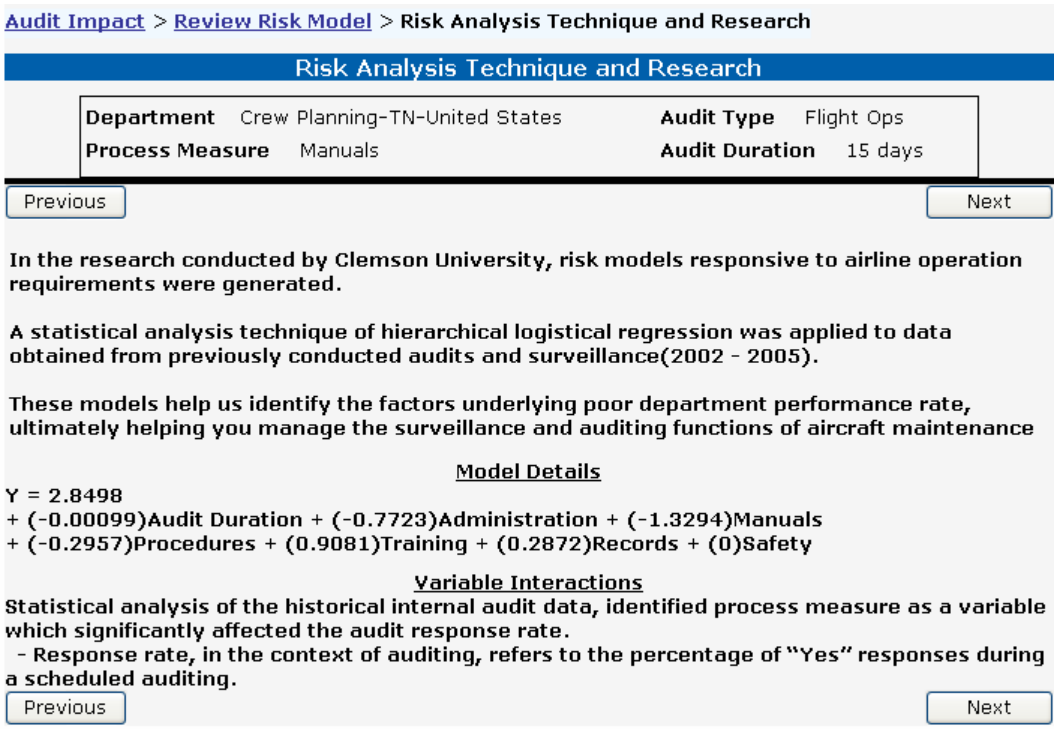


Figure LXIV. *Audit Duration and Process Measure effect*

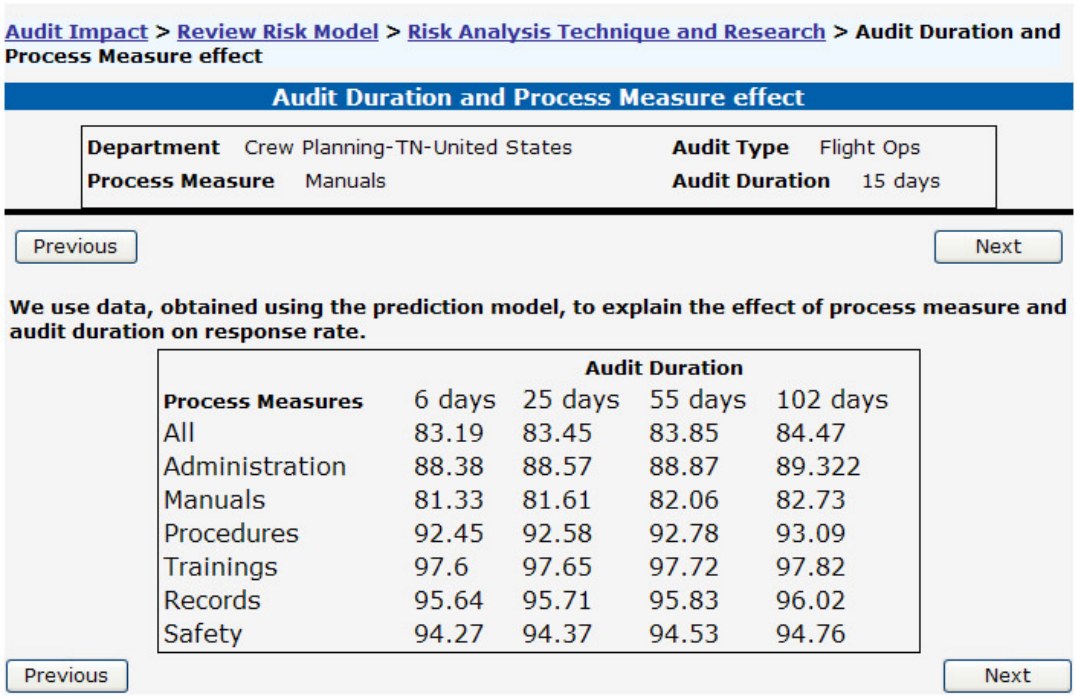
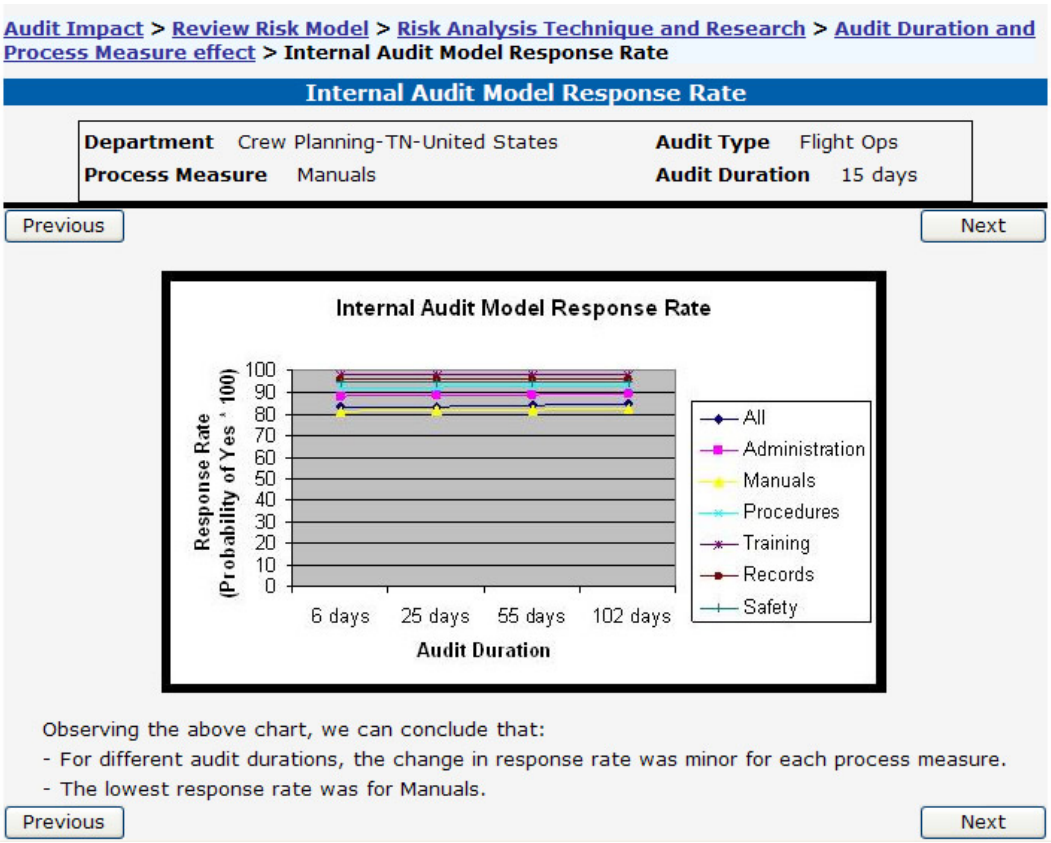


Figure LXV. *Internal Audit Model Response rate*



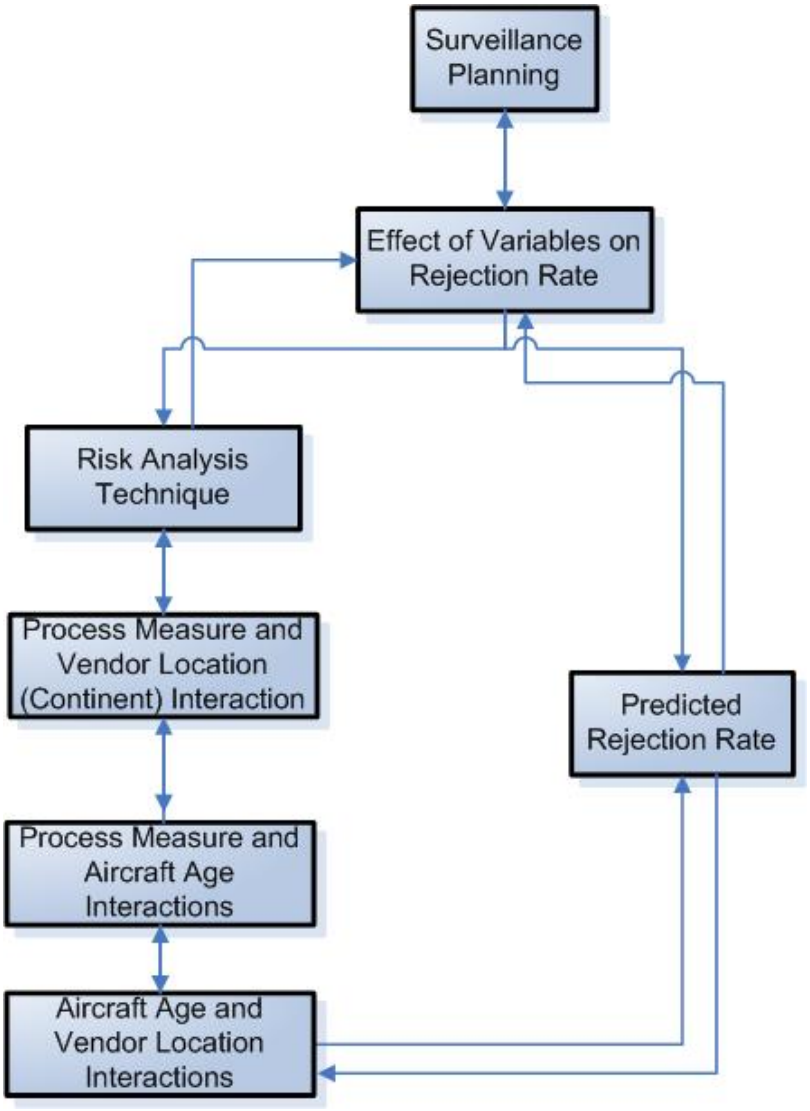
6.5.4 Internal Audit Module Screens- Audit Allocation

The details on the screens in the Audit Allocation section have been presented in Chapter V. The revisions made to the Audit Allocation section screens are identical to those made to the Audit Impact section screens. No changes were made to the Audit Allocation page.

6.5.5 Surveillance Module Screens- Surveillance Planning (Surveillance Representatives)

The revised product map for the Surveillance module's Surveillance Planning screens is shown in Figure LXVI. The revision involved combining the Surveillance Model Details page, Risk Analysis Technique page, and the Understanding Variable Interaction page into a single page. The participants considered these pages to be "one time use only" pages.

Figure LXVI. *Surveillance Planning Product Map (Surveillance Representatives)*



The details on the screens in the Surveillance Planning tool have been presented in Chapter V. This section illustrates the revisions made to the Surveillance Planning tool screens. The revisions made to the Surveillance Planning screens are identical to those made to the Technical Audit module's Audit Impact tool screens. The revised screens are shown in the figures below.

Figure LXVII. *Effect of Variables on Vendor Performance*

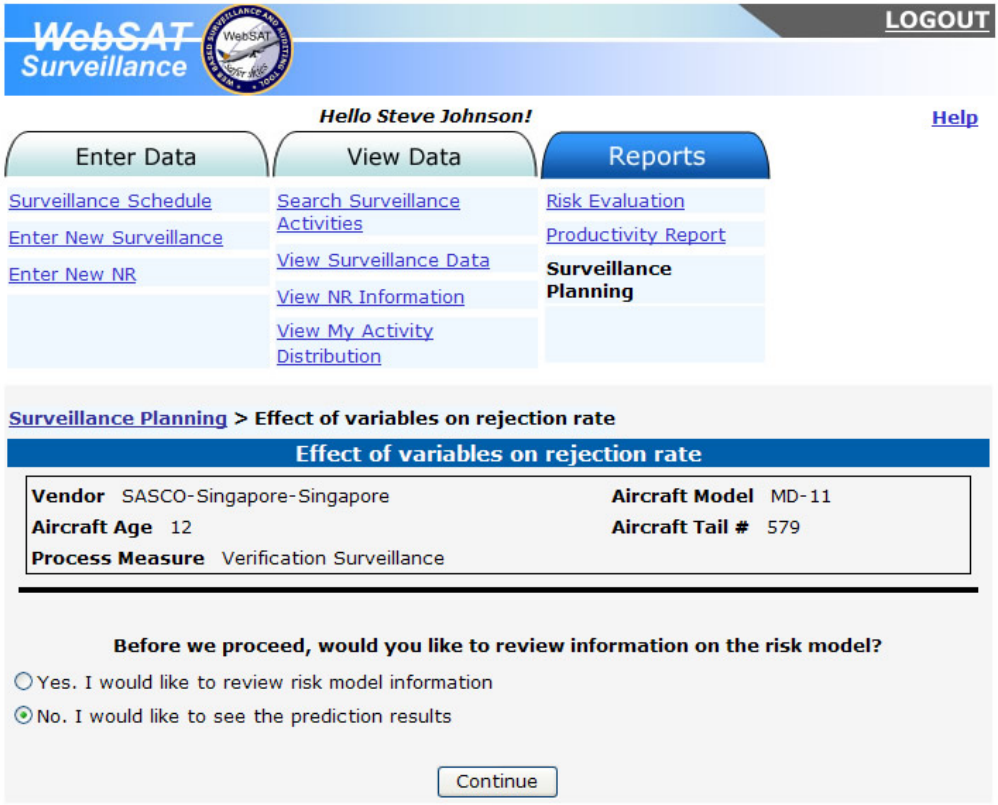


Figure LXVIII. *Risk Analysis Technique*

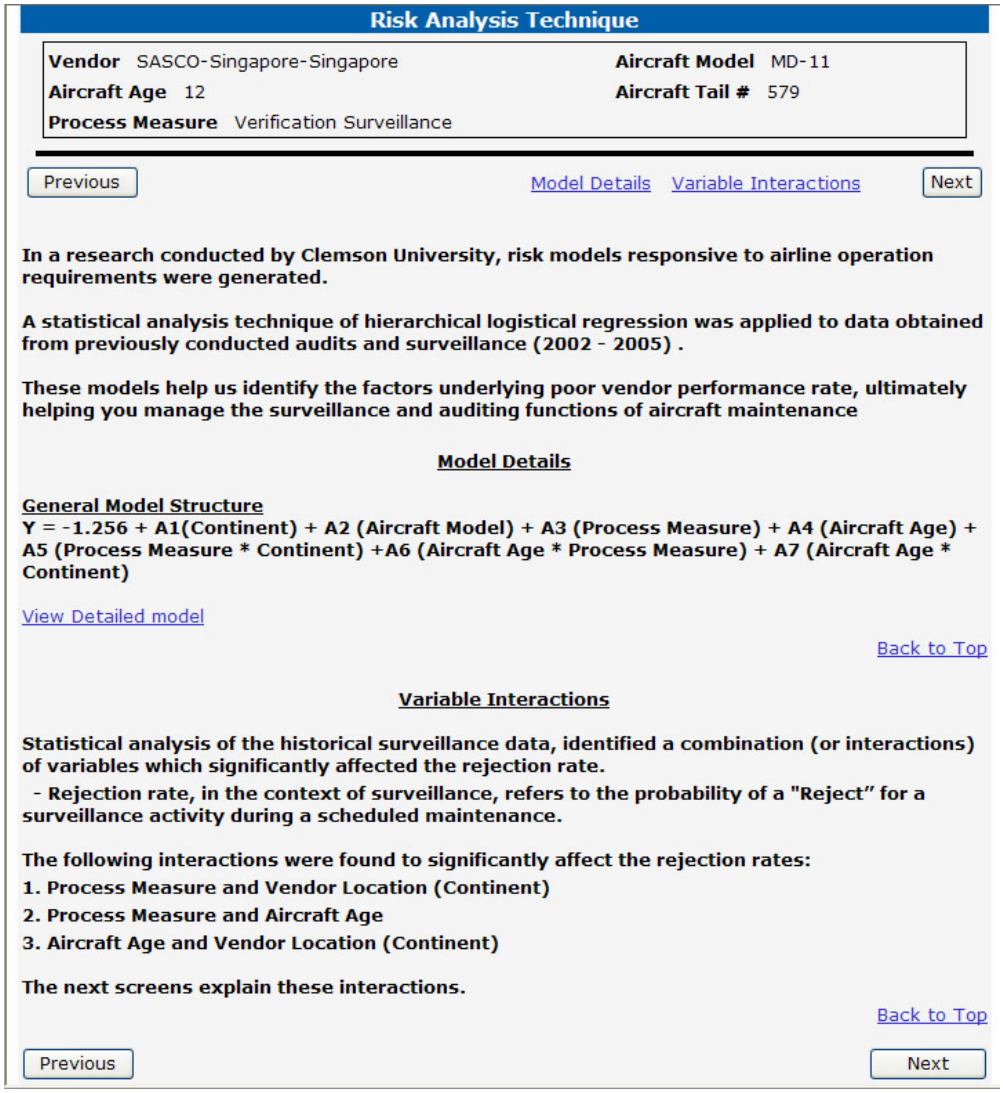


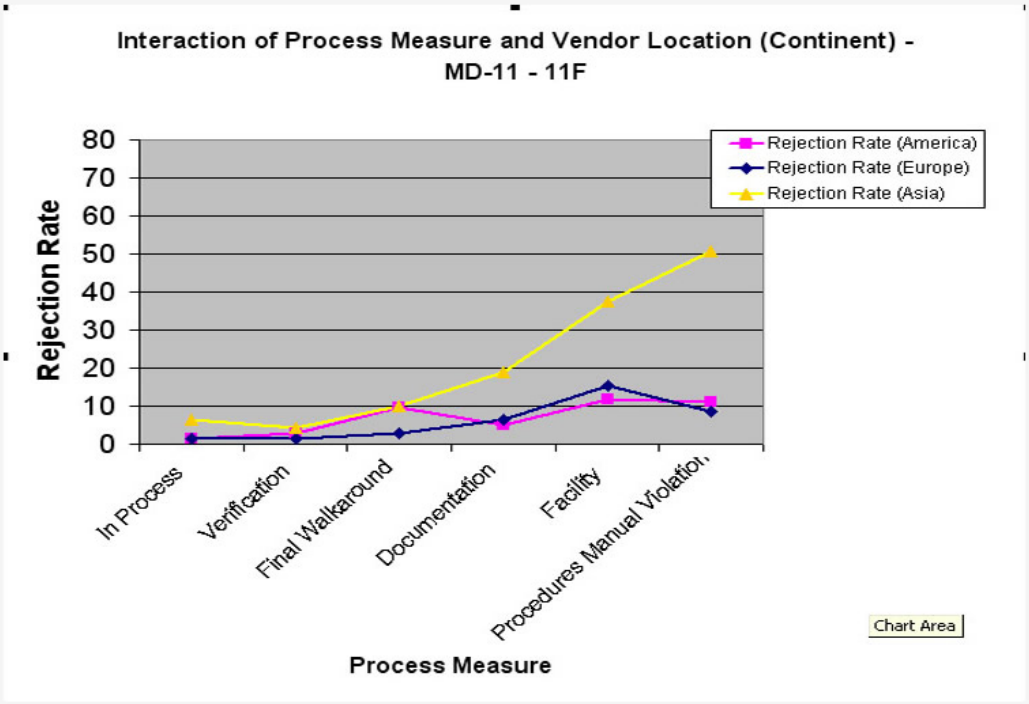
Figure LXIX. *Process Measure and Vendor Location (Continent) Interactions*

Process Measure and Vendor Location (Continent) Interaction Graph(s)

Vendor SASCO-Singapore-Singapore	**Aircraft Model** MD-11
Aircraft Age 12	**Aircraft Tail #** 579
Process Measure Verification Surveillance	

Previous | Show All | Next

ProcessMeasure * Vendor Location - MD-11



Observing the above chart for interaction between process measure and vendor location (continent), we can conclude that:
-For vendors located on the Asian continent, the *rejection rate is high* for process measures of Documentation, Facility and Procedures Manual Violation.
-For all vendors, the *rejection rate for the Facility process measure is high* compared to other process measures.

Previous | Next

Figure LXX. *Process Measure and Aircraft Age Interaction*

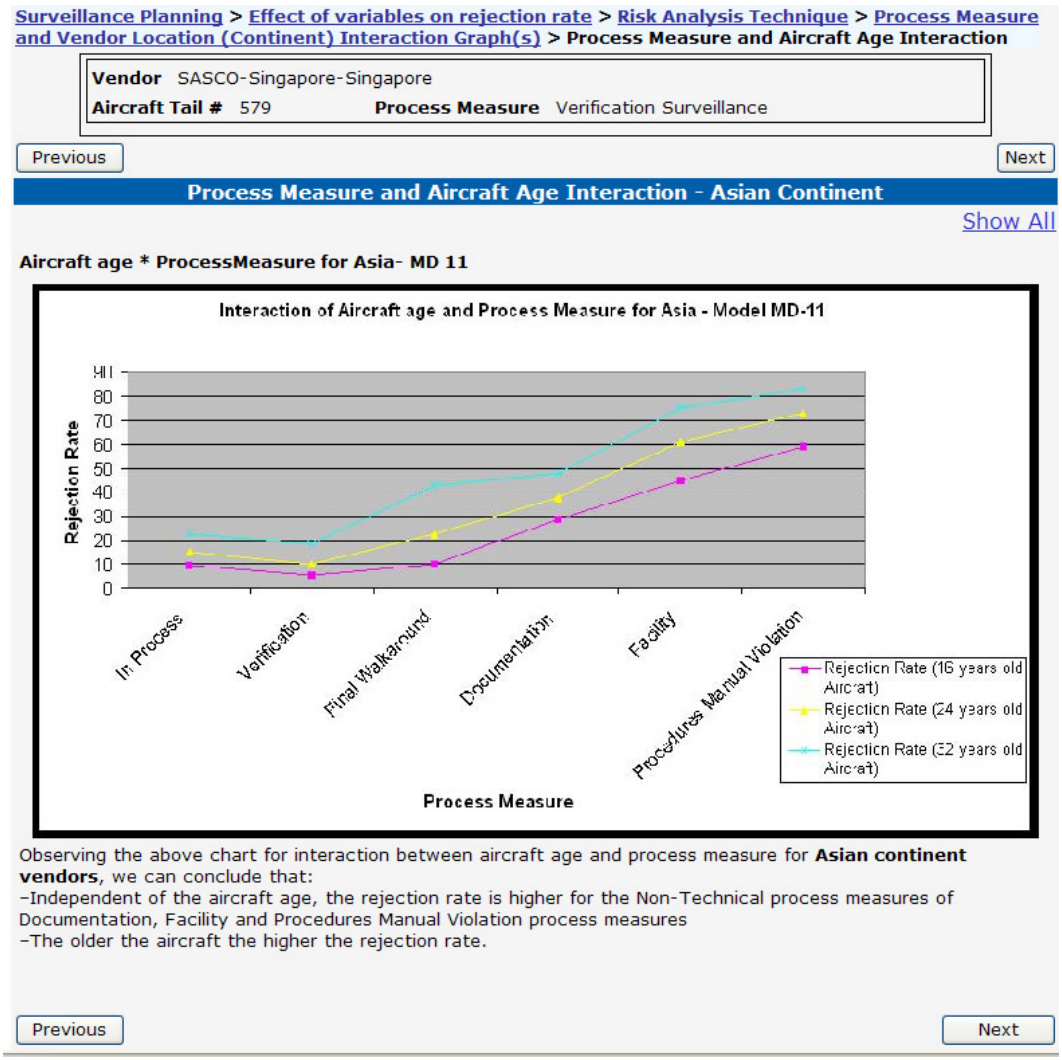
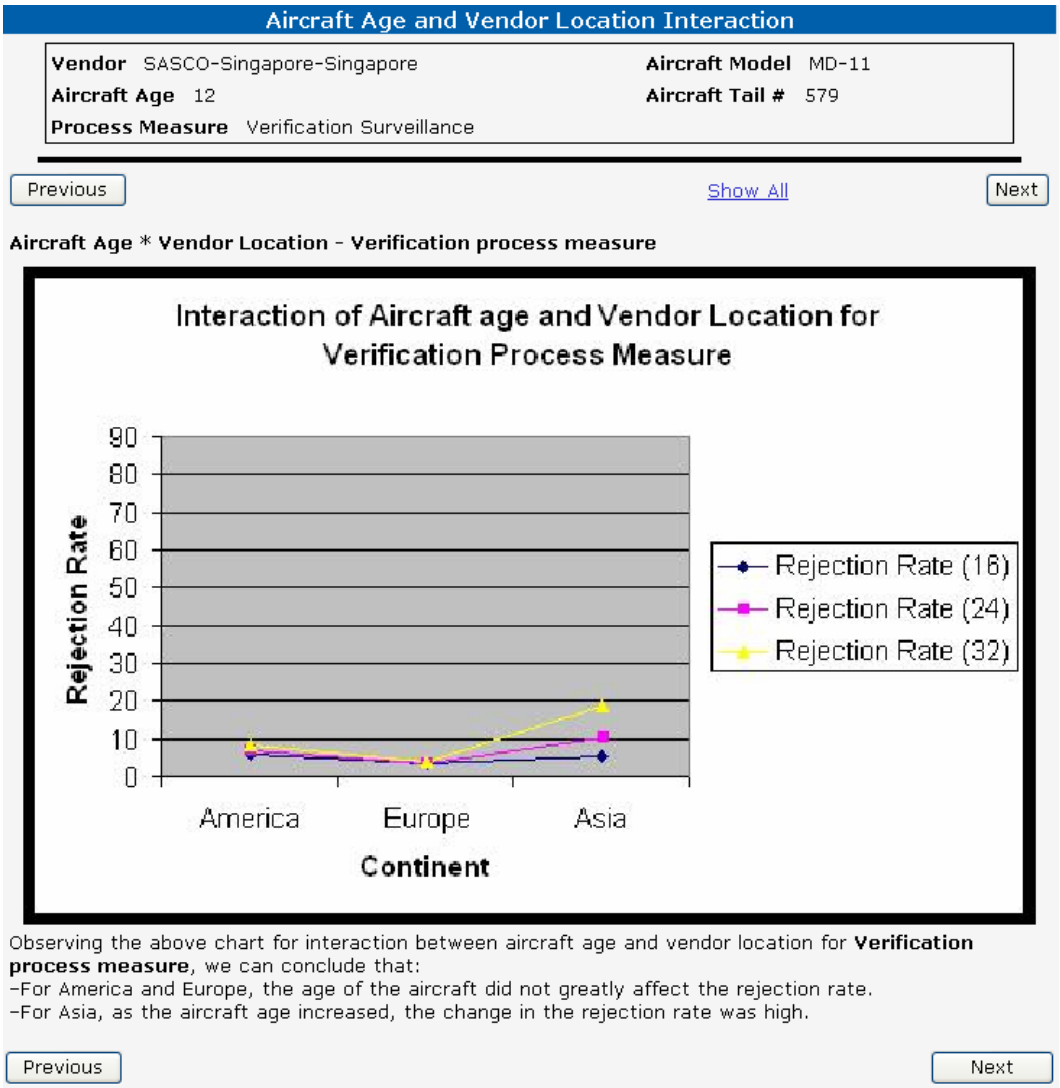


Figure LXXI. *Aircraft Age and Vendor Location Interaction*



6.5.6 Surveillance Module Screens- Surveillance Planning (Manager)

The details on the screens in the Surveillance manager's Surveillance Planning tool have been presented in Chapter V. The revisions made to the Surveillance Planning tool screens are identical to those made to the Technical Audit module's Audit Impact tool screens. No changes were made to the Surveillance Planning page.

CHAPTER VII: DISCUSSION OF EXPERIMENTAL RESULTS

This chapter discusses the results of the experiments and presents the participants' feedback on the model. It has three main sections, each consisting of discussion of a WebSAT module experiment.

7.1 Technical Audit Module – Auditor and Manager

The response rate results in terms of *p* value for the Prediction Capability, Impact and Planning Capability Experiments are presented in Table LV. The significant result is displayed in bold and italics and those close to significance ($p < 0.1$) have been underlined. The " – " in the table indicates that the experiment was not conducted with the participant type. During the Prediction Capability and Impact Experiment without the model, auditors pointed out that the Audit Impact tool would be more useful to a manager than to them. However, after the Prediction Capability and Impact Experiment with the model, a majority of the auditors said that an auditor would benefit from the model review section in understanding the predictor variables' effects on the response rate and thereby prepare for a scheduled audit.

The results from the Graphical Effectiveness Experiment show that the auditors and managers were able to review and interpret the graphs in the model review section accurately. The dominant feedback in this section was the appreciation for customizing the graphs to the parameters set in the Audit Impact and the Audit Allocation page. The managers also appreciated the Show All link, as it gave them

the opportunity to assess the effect of other parameter levels by viewing all the graphs shown. The results of the SUMI analysis also indicate that the participants rated the Audit Impact and Audit Allocation tool highly in the five specific SUMI scales of Efficiency, Affect, Helpfulness, Control and Learnability as well as in terms of Global Usability. Similarly, high ratings were seen in the feedback questionnaire analysis for WebSAT with the Audit Impact and Audit Allocation tools. However, the ratings on only three out of the six criteria were significantly different indicating the prediction and planning tools could be improved for information retrieval and its availability of important information.

Table LV. *Technical Audit Module Results (Response Rate)*

Module	Participant type	N	Significance			Graphical Effectiveness
			Prediction	Impact	Planning	
			p values			(% responses matching model outcome)
Technical Audit	Auditor	5	.067	***.038***	-	100
	Manager	2	-	.183	.070	100

In general, there were mixed responses from auditors and managers. These responses have been discussed below.

7.1.1 Effect of Audit Type

Considering the two way interaction of Audit Duration and Audit Type from the model results, as the audit duration increased to 63 days, the Supplier audit shows low response rate. Some auditors believed that Ramp Operations and Line audits would always give higher response rates than Supplier audits. "Ramp or Line (audits) are within your own company. Suppliers take more time and reveal more findings." said one auditor. On the other hand, one auditor felt that Line

Maintenance departments do not have quality assurance personnel and hence evidence more problems even though they are directly associated with the airline. On observing the interaction between the audit duration and audit type in the model review section, the auditors and managers agreed that a supplier audit that has produced more findings tends to take time to complete because of the time taken by the supplier to implement corrective actions on the findings listed in the audit report.

7.1.2 Effect of Auditor Experience

Considering the two way interaction of Auditor Experience and Continent for vendor location from the model results, as the auditor experience decreased there is a change in the response rate albeit small, especially for the American continent. "Auditor experience comes in handy only when the audit duration is long" said an auditor. Two auditors believed that experience had nothing to do with audit response rate. They believed that the airline trains all the auditors to the same level of expertise. One auditor believed that lower experience results in higher response rates, as the inexperienced auditor overlooks certain discrepancies that more experienced auditors do not. One auditor also believed that an auditor with less experience would be more critical in each review he/she does and will have higher expectations, leading to more findings. This would also lead to more prolonged audits.

7.1.3 Effect of Audit Duration

Considering the two way interactions of Audit Duration and Audit Type and Audit Duration and Continent for vendor location, as the time taken to complete the audit increased, the response rate for the audit decreased. "Audit duration should be broken down into time taken to conduct the audit and time taken for the vendor to respond to the findings." said an auditor. This would allow auditors to interpret the

audit duration information more appropriately. The auditors believed that the time taken in an audit is important for long duration audits and not for short audits. The auditors also believed that each type of audit has an average duration. Consequently, for a given type of audit, a shorter duration results in a higher audit response rate. The managers and auditors believed the model results for the audit duration and audit type interaction were as expected and that longer audits indicate more time taken to possibly identify more findings and thus giving definite reasons for lower response rate. Two auditors and the managers thought that time should not affect the response rate. One manager believed that although fuel audits typically take more time than line audits, audit time was not a predictor of response rate.

7.1.4 Effect of Vendor Location

The two way interactions of Audit Duration and Continent for vendor location and Auditor Experience and Continent indicate that Asia displayed a very high response rate regardless of the auditor experience or the audit duration. Commenting on vendor location and audit durations, an auditor and a manager stated that international audits involve significant time travel. The fatigue associated with the travel also affects the auditor's efficiency in conducting an audit. The location of the vendor was considered by two of the auditors in terms of cultural and language barriers. For example, the Japanese locations are more conducive to effective audits than the Chinese locations. All the auditors unanimously complained about language problems in China. Further, as the location changes, the regulatory body monitoring the vendor also changes. For example, the Civil Aviation Administration of China has different regulations than its American counterparts. On the other hand, two auditors felt that if the same vendor were to open operations

on a different continent, there would be no difference in the performance of the vendor, as they would carry the same work ethics and culture to the new location. Further, observing the model results displaying the effect of auditor experience, particularly, on the European and American continents, one auditor explained that Asian vendors have a greater tendency to improve over time and learn from their mistakes.

7.1.5 Other Possible Predictor Variables

Commenting on the general nature of the audit findings, an auditor said, "It is difficult for one finding to be permanently resolved." Two auditors had developed their own subjective weights for findings. For example, findings related to a lack of self-audit programs at vendor locations were considered to be more serious than other findings, as vendors with such programs tend to self evaluate themselves, allowing the auditor to focus on other issues. Further, such programs address systemic problems which are important and difficult to address by one audit visit. However, two other auditors did not deliberate on the type of finding. Instead, they looked at the number of findings. One of the two auditors pointed out that the sample an auditor considers during an audit decides how he/she will steer the audit. Thus, if he/she looks at a sample of good results, obviously the audit will show good results. An auditor said that no matter how good the fix, certain types of findings tend to repeat themselves periodically. For example, findings related to training tend to repeat themselves.

Auditors also pointed to other factors that may affect audit response. Two auditors considered the period the vendor has done business with the airline in making their predictions. For example, one of the vendors in the experiment was

more closely scrutinized after it opened a new service station with the airline. Most of the auditors rotate to conduct audits on other audit types, once in say three years or more. Further, the vendors that the airline does business with also change. This makes it difficult for auditors to predict response rates for other audit types. Under such circumstances, I observed that they also relied on information they had heard from their colleagues, in addition to the historical data.

7.1.6 Manager Feedback on Audit Allocation

The managers were of the general opinion that the different predictor variables should not affect the response rate. They strongly believed that response rate was independent of the audit type, auditor experience, vendor location and audit duration. However, they acknowledged that this expectation may be the goal rather than the reality. One manager emphasized that an auditor new to the airline is accompanied by a senior auditor during the first few audits. This new auditor is allowed to conduct audits only when the manager and auditing team are convinced that the new auditor is capable of conducting the audit individually.

The results for the combinations chosen in the Planning Capability Experiment, as shown in Table XL in Chapter VI, indicate that the managers identified the same combinations as those predicted by the model. This indicates that the managers understand the general effect of the parameters on the response rate. The lack of significant results for the managers on the Impact and Planning Capability Experiment suggests that there is no improvement in the manager's planning capabilities and ability to understand the effect of a change in the level of a predictor on audit response rate by using WebSAT with the model. However, the near significant (p = 0.07) results for the Planning Capability Experiment, suggest

that a larger sample size could reveal that there is a significant improvement in the manager's planning capabilities when using the Audit Allocation tool.

With respect to the Audit Allocation tool and its capabilities, the managers believed that it was a step in the right direction. However, more information would be needed to allow the manager to use the tool to make an allocation. The workload associated with each auditor was one item of information that they would like to see. The manager suggested that WebSAT include a scheduling capability to accommodate this variable. They added that the information provided in the model review section was useful and added value in assisting interpretation of the factors affecting an audit. They also recognized that the Allocation tool would benefit if more factors were included.

7.1.7 Time Taken to Complete Experiments

The significance results in terms of p value for the time taken to complete the experiments are presented in Table LVI for the Prediction Capability, Impact and Planning Capability Experiment. Those results which are significant ($p < 0.05$) are displayed in bold and italics. The results that approached significance ($p < 0.1$) are underlined. The " – " in the table indicates that the experiment was not conducted with the participant type.

The time taken by the auditors to make predictions in the Prediction Capability and Impact Experiments using WebSAT with and without the model was significantly different as seen in Table LVI. Similar results were obtained from managers in the Planning Capability Experiment. Thus, Tables XXII, XXXVII and LVI indicate that the Audit Impact and Audit Allocation tools assisted the auditors in using WebSAT to predict vendor performance quickly. However, it must also be

noted that since the tests in each experiment were always conducted in the same order – WebSAT without the model followed by WebSAT with the model, the auditor and manager did not spend time reviewing a vendor's past performance in Test 2 and directly chose WebSAT's Audit Impact and Audit Allocation sections, respectively, to make a prediction. Consequently, this may have also been a cause for the shorter time taken to complete Test 2.

Table LVI. *Technical Audit Module Significance Results (Time)*

Module	Participant type	N	Significance		
			Prediction	Impact	Planning
Technical Audit	Auditor	5	***.049***	***.045***	-
	Manager	2	-	.086	***.021***

7.2 Internal Audit Module – Auditor and Manager

The response rate results in terms of p value for the Prediction Capability and Impact Experiments are presented in Table LVII. The significant results are displayed in bold and italics and the near significant result ($p < 0.1$) is underlined. The " – " in the table for participant type auditor indicates that the experiment was not conducted while for participant type manager, due to a sample size of one, no significance test was conducted.

The results of the Graphical Effectiveness Experiment show that the auditors and manager were able to review and interpret the graphs in the model review section accurately. The auditors and manager believed that there are more variables that should be considered as candidates for predictor variables. The manager commented that the graphical section is a good technique to illustrate model variables and their effect on response rate. Following the experiment, the manager felt that for the Audit Allocation tool to accomplish its task, more auditor

and vendor/ department related information would need to be added to the regression model.

Table LVII. *Internal Audit Module Results (Response Rate)*

Module	Participant type	N	Significance			Graphical Effectiveness
			Prediction	Impact	Planning	
			p values			(% responses matching model outcome)
Internal Audit	Auditor	4	.097	***.001***	-	100
	Manager	1	-	-	-	100

The results of the SUMI analysis indicate that the participants rated the Audit Impact and Audit Allocation section favorably along the five specific SUMI scales of Efficiency, Affect, Helpfulness, Control and Learnability as well as on the Global Usability Scale. Similarly, high ratings were seen in the feedback questionnaire analysis for WebSAT with the Audit Impact and Audit Allocation tools. However, the ratings on only three out of the six criteria were significantly different indicating the prediction and planning tools could be improved for information retrieval and its availability of important information.

7.2.1 Effect of Process Measures and Audit Duration

The model results indicated that the process measure Manuals resulted in a low response rate as compared to the other process measures. The general approach followed by the auditors was to review the historical data and make a prediction. The prediction depended on the process measures involved in the task. The type of findings also affected their prediction. For example, findings related to inadequate training were considered to recurrent and less serious as compared to systemic findings such as self audit policies. "Department is slow to buy into the self audit policy." said an auditor. The auditors paid little attention to the audit or department

type. In the Impact Experiment, the auditors indicated that higher audit duration involved "digging more dirt" and consequently resulting in more audit findings and a lower response rate.

7.2.2 Other Possible Predictor Variables

After the experiment, when the auditors were asked what other variables could affect response rate, the auditors in general pointed to their experience in the field and how they have learned where to look and how much importance they should give to a finding. They indicated that the WebSAT tool should employ a similar strategy for each audit finding to indicate the importance of each finding. Since the departments audited belong to the airline, there is a tendency for the auditors to give high response rates. A similar comment was made by an auditor on observing the graph in the model review section which showed generally high response rates.

7.2.3 Manager Feedback on Audit Allocation

The manager agreed with the model findings that the type of process measure affects the response rate. He attributed this primarily to a human tendency to pay less attention to paperwork and concentrate on the task at hand. He also believed that audit duration was an irrelevant factor. He said, "Once a part of the system is identified as deficient and the answer is "no", additional samples do not change this outcome. Additional areas may be found deficient but this is not as likely." He also explained that audit duration is very misleading, as it does not indicate if it was the actual audit or the corrective action process which took a lot of time.

The results for the combinations chosen in the Planning Capability Experiment, as shown in Table XLIV in Chapter VI, indicate that the manager identified same combinations as the model, with the exception of task 3. As shown in the task sheet in Appendix X, task 3 involved choosing between two different audit durations and the manager chose shorter audit duration unlike the model. However, the manager's overall performance in selecting combinations, as shown in the combination table, is an indication that the manager understands the general effect of the process measures on the response rate. From Table XLI in Chapter VI, observing the small difference in the means for the Planning Capability and Impact Experiments, one would conclude that the manager was not assisted by the Allocation tool and that he understands the effect that a change in variable level will have on the response rate. In response to the Audit Allocation tool and its capabilities, the manager stated that more information would need to be accounted for in the tool to be of value in making an allocation.

7.2.7 Time Taken to Complete Experiments

The significance result in terms of *p* value for the time taken to complete the experiments is presented in Table LVIII for the Prediction Capability and Impact Experiments. Those results which were significant ($p < 0.05$) are displayed in bold and italics. The near significant results ($p < 0.1$) are underlined. The " – " in the table for participant type auditor indicates that the experiment was not conducted while for participant type manager, due to a sample size of one, no significance test was conducted.

The time taken by the auditors to make predictions in the Prediction Capability and Impact Experiments using WebSAT with and without the model was

significantly different as seen in Table LVIII. Similar results were obtained from managers in the Planning Capability Experiment. Thus, Tables XXVII, XLII and LVIII indicate that the Audit Impact and Audit Allocation tools assisted the auditors in using WebSAT to predict department performance quickly. However, it must be noted that since the tests in each experiment were always conducted in the same order – WebSAT without the model followed by WebSAT with the model, the auditor did not spend time reviewing a department's past performance for Test 2 and directly chose the WebSAT's Audit Impact tool to make a prediction. Consequently, this may have also been a cause for the shorter time taken to complete Test 2.

Observing the time values in Table XLII in Chapter VI, the difference in the time taken for the Planning Capability Experiment Test1 and Test 2 is large. This may indicate that the tool assisted the manager to complete the experiment quickly. However, since no significance test could be conducted, no conclusion can be drawn.

Table LVIII. *Internal Audit Module Significance Results (Time)*

Module	Participant type	N	Significance		
			Prediction	Impact	Planning
Internal Audit	Auditor	4	***.050***	.096	-
	Manager	1	-	-	-

7.3 Surveillance Module – Representative and Manager

The rejection rate results in terms of *p* value for the Prediction Capability, Impact and Planning Capability Experiments are presented in Table LIX. Those results which are significant ($p < 0.05$) have been displayed in bold and italics. The " – " in the table indicates that the experiment was not conducted with the participant type. After conducting the experiments, the surveillance representatives expressed that the Surveillance Planning tool would be helpful to them in assessing the effect of aircraft age on rejection rate. The surveillance representatives added that

they would also benefit from the model review section in understanding the predictor variables' effects on the rejection rate and thereby prepare for a scheduled maintenance.

The results from the Graphical Effectiveness Experiment show that the auditors and managers were able to review and interpret the graphs in the model review section accurately with the exception of manager participant 3's response for task 3. I observed that the manager was tracking the Asian line in the graph instead of the European line which resulted in his incorrect choice. When the manager was asked about any inadequacies in the graph legend he felt they were clear and visible. The representatives noticed the contextual presentation of graphs related to the parameters set in the Surveillance Planning pages. The results of the SUMI analysis also indicate that the participants rated the Surveillance Planning section favorably along the five specific SUMI scales of Efficiency, Affect, Helpfulness, Control and Learnability as well as along the Global Usability Scale. Similarly, high ratings were seen in the feedback questionnaire analysis for WebSAT with the Surveillance Planning tool. However, the ratings on only three out of the six criteria were significantly different indicating the prediction and planning tools could be improved for information retrieval and its availability of important information.

Table LIX. *Surveillance Module Results (Rejection Rate)*

Module	Participant type	N	Significance			Graphical Effectiveness
			Prediction	Impact	Planning	
			p values			(% responses matching model outcome)
Surveillance	Represen-tatives	8	***.013***	***.003***	-	100
	Manager	3	-	.171	.188	93

The data from the Prediction Capability and Impact Experiments indicate that there was significant improvement in vendor performance prediction capabilities and the representatives' ability to understand the effects of changes in the levels of the predictors on the rejection rate by using WebSAT with the model. During the experiment, the representatives and managers also provided their comments on the effect of the predictor variables on rejection rate. In general, there were mixed responses from the representatives. These responses are discussed below.

7.3.1 Effect of Aircraft Age

The model results indicate that the rejection rate increased as the age of the aircraft increased. The representatives and managers believed that the age of the aircraft indicates the wear and tear on aircraft. Further, with technological advancement, the managers believed that maintainability of a new aircraft is far easier than for older ones. However, a few representatives stated that rejection rate is based on the ability of the vendor to perform maintenance and the age of the aircraft does not affect rejection rate. The same group also thought that the rejection rate is independent of the aircraft type. After the experiment, the managers could not explain the opposite trend observed with aircraft age for Documentation Surveillance where younger aircraft show a higher rejection rate.

7.3.2 Effect of Aircraft Type

In general, the surveillance representatives felt that rejection rate is independent of aircraft type itself. However, the managers felt that larger and more complex aircraft have a higher rejection rate than smaller and younger aircraft.

7.3.3 Effect of Vendor Location

The model results indicated a higher rejection rate for the vendors from the Asian continent compared to the American and European vendors. Unlike the managers, the representatives felt that the vendors on the European continent yielded lower rejection rates than American vendors. Three representatives believed that location of the vendor does not affect the rejection rate, as it is a result of the maintenance activity performed on the aircraft, which they believe is independent of vendor location. The managers believed that the vendor affects the rejection rate. Some vendors perform more poorly than other vendors. European and American vendors were expected to produce higher rejection rates than Asian vendors by the managers.

The managers were surprised to see the poor performance of Asian vendors. In the recent past, they have observed tremendous improvement in the Asian vendors' performance. Two of the three managers pointed out that the airline has changed Asian vendors in search of better aircraft maintenance. I asked one of the managers who had been a Technical Audit Manager in the past, to explain the reason for the contrasting results between Asian vendors for Technical Audits and those for Surveillance. He explained that in an audit, there are several opportunities for an error or finding to go unnoticed as it depends on the sample the auditor chooses and the ability of the auditor to accommodate immediate corrective actions. However, in a Surveillance environment, it is more likely that errors will be detected and documented.

To explain the differences in rejection rates across continents, a representative stated that cultural differences and the stability of the maintenance

workers in certain countries could be possible causes. The vendors' familiarity with maintenance on a particular aircraft type would also influence rejection rates. Further, for non- North American vendors, both language barriers and understanding of the maintenance program requirements could affect the rejection rates. A surveillance representative suggested that the Asian vendors' inability to pass information onto maintenance personnel performing a task as possible reason for a higher rejection rate. It was also observed during the experiment that the representatives have certain profiles of vendors based on locations. For example, one of the representatives commented that Singapore has a very proud work force and strong company loyalty.

7.3.4 Effect of Process Measures

The model results indicated that technical process measures produced low rejection rate as compared to non-technical process measures. In particular, the non-technical process measures of Facility Surveillance and Procedures Manual Violation produced high rejection rates. The representatives had mixed opinions on the effects of process measure In Process Surveillance. Some representatives believed that the In Process surveillance yielded higher rejection rates, as the surveillance is conducted in the presence of the surveillance representative. On the other hand, some representatives believed that In Process surveillance would result in fewer rejections as the representative would give the maintenance personnel an opportunity to correct a finding in his presence. Most representatives agreed that non-technical process measures result in higher rejection rates than the technical process measures.

The managers also believed that rejection rate varied based on process measure type. For example, one of the managers thought that In Process surveillance would yield a lower rejection rate than other process measures. Two surveillance

representatives commented that Verification surveillances always provide a higher rejection rate than "In Process" surveillance. At the same time, non-technical process measures have a higher rejection rate than the technical process measures. After observing the higher rejection rate for the Final Walkaround process measure with American vendors, a representative believed this could be attributed to the larger number of aircraft being maintained in America. Further, since this would be the final opportunity for the representative to review the aircraft, the representative added that this results in a large number of findings being made during Final Walkaround.

7.3.5 Other Possible Predictor Variables

The representatives prefer to concentrate on technical process measures, such as In Process and Verification Surveillances, rather than non-technical process measures related to house keeping, such as Facility Control. Consequently, they have a tendency to conduct non-technical surveillances in bulk. This may contribute to higher rejection rates for non-technical process measures. The representatives also believe that the number of different airlines a vendor does business with affects the rejection rate. Since each airline enforces surveillance differently, the vendor's maintenance personnel are subjected to different performance demands. The maintenance personnel also have to follow procedures prescribed by the vendor, as well as those required by the airline whose aircraft he/she is working on. The period the vendor has done business with the airline helps to address this problem, as it may allow the maintenance personnel to familiarize themselves with the airline's expectations.

Some of the other factors that affect rejection rate, suggested by the representatives are differences among surveillance representatives and the types of aircraft the representative is familiar with. Further, the number of vendor locations that a surveillance representative is familiar with varies, possibly affecting the representatives' ability to identify maintenance issues.

7.3.6 Manager Feedback on Surveillance Planning

The managers were of the general opinion that the different predictor variables should affect the rejection rate. Commenting on the differences among surveillance representatives, a manager explained that that airline trains their representatives to minimize inconsistencies in surveillance operations.

The results for the combinations chosen in the Planning Capability Experiment, as shown in Table L in Chapter VI, indicate that the managers identified same combinations to those predicted by the model. This indicates that the managers understand the general effects of the predictor variables on the rejection rate. From Table LIX, observing managers' non-significant results for the Impact and Planning Capability Experiments, one can conclude that the managers understand the effect of a change in predictor variable level on the rejection rate.

In response to the Surveillance Planning tool and its capabilities, the managers believed that it is a step in the right direction. However, it is inadequate to assist the managers in planning as more information is needed. The typical planning a manager would perform is assigning surveillance representatives to vendor locations. In order to allow the manager to make such an allocation, the Surveillance Planning tool and hence the model needs to consider the surveillance representative to be a predictor variable. The experience, familiarity of the representative with

various aircraft types and workload associated with each representative were some of the items of information that they would like to see available in the Surveillance Planning tool. That said, the managers also appreciated the value that the model review section provides to them and the representatives. Similar feedback was received from the representatives, who felt that the model review section would assist them in understanding the factors affecting a surveillance activity.

7.3.7 Time Taken to Complete Experiments

The significance results in terms of *p* value for time taken to complete the experiments are presented in Table LX for the Prediction Capability, Impact and Planning Capability Experiments. Those results which were significant ($p < 0.05$) are displayed in bold and italics. The " – " in the table indicates that the experiment was not conducted with the participant type.

The time taken by the auditors to make predictions in the Prediction Capability Experiment using WebSAT with and without the model was significantly different as seen in Table LX. Results obtained from managers in the Planning Capability Experiment were also similar. Thus, Tables XXXII, XLVII and LX indicate that the Surveillance Planning tool assisted the representatives in using WebSAT to predict vendor performance quickly.

Since the tests in each experiment were always conducted in the same order – WebSAT without the model followed by WebSAT with the model, the representatives and managers did not spend time reviewing a vendor's past performance in Test 2 and directly chose the WebSAT's Surveillance Planning section to make a prediction. Consequently, this may have also been a cause for the

shorter time taken to complete Test 2 in the Prediction Capability and Planning Capability Experiments.

The effect of WebSAT on the time taken by the participants to complete the Impact Experiment was not significant indicating that using the Surveillance Planning tool made no difference in the time taken to predict rejection rates.

Table LX. *Surveillance Planning Significance Results (Time)*

Module	Participant type	N	Significance		
			Prediction	Impact	Planning
Surveillance	Represent-atives	8	***.004***	.672	-
	Manager	3	-	0.425	***.011***

CHAPTER VIII: CONCLUSIONS AND RECOMMENDATIONS

This research developed models to predict the performance of vendors and departments. It involved collection of historical data on the various available variables. The historical data was used to generate models using the logistic regression technique in SAS - a statistical analysis tool. Three models, one each for surveillance, technical audit and internal audit were generated. The generated models were implemented in WebSAT in the Reports global navigation tab appearing under the Audit Impact, Audit Allocation and Surveillance Planning sections. The interfaces of these tools were evaluated using the SUMI usability questionnaire and a short feedback questionnaire.

Experiments were conducted to evaluate the utility and planning capability of the model and their results are presented in Table LXI. The two near significant results and one significant result for the Prediction Capability Experiment, suggest that the Audit Impact and Surveillance Planning tools enhance the auditors' and the surveillance representatives' vendor/ department performance prediction capabilities using WebSAT with the model. The significant results for technical auditors, internal auditors and surveillance representatives for the Impact Experiment indicate that there was significant improvement in the auditors' and representatives' ability to understand the effect of a change in the level of a predictor on rejection rate by using WebSAT with the model. The technical audit and surveillance managers' non-significant results indicate that the Audit Allocation and Surveillance Planning tools are not as useful for managers. It is important to improve the capabilities of the

planning tools by employing more variables in the regression models including information on surveillance representatives and auditors.

Table LXI. *Experiment Results (All Modules)*

Module	Participant type	N	Significance			Graphical Effectiveness
			Prediction	Impact	Planning	
			p values			(% responses matching model outcome)
Technical Audit	Auditor	5	.067	***.038***	-	100
	Manager	2	-	.183	.070	100
Internal Audit	Auditor	4	.097	***.001***	-	100
	Manager	1	-	-	-	100
Surveillance	Represen-tatives	8	***.013***	***.003***	-	100
	Manager	3	-	.171	.188	93

The results from these experiments indicate that auditors and surveillance representatives are not of one mind regarding the effect of predictor variables on vendor and department performance. The sections below present the conclusions derived for each work function, followed by a set of recommendations for future research.

8.1 Technical Audit

The following conclusions can be drawn based on the results of this research:

1) The auditors took significantly more time to make predictions using WebSAT without the model than they did using it with the model.
2) The auditors and managers agreed with the results displayed by the model. The auditors felt the model review section would prove more beneficial to them than the model's predictions.

3) The auditors suggested that auditor experience could be presented in terms of time spent various vendor sites and audit types. They felt that this would allow the manager to better assess an of the auditor's capabilities.
4) The general consensus was that audit duration should be broken down into time taken to conduct the audit and time taken for the vendor to respond to the findings to allow for more meaningful interpretation of the audit duration information.
5) In general, the auditors and managers agreed that vendor characteristics affect response rate. Some characteristics, such as culture and language, are associated with the vendor location. However, in certain cases, for example, with Japanese vendors, culture is considered to be a contributor to high performance. Period of business was another vendor characteristic which was identified by the auditors as a possible predictor variable affecting audit response rates.
6) Auditors have developed their own subjective weights for audit findings. It would be worthwhile understanding what these subjective weights are to allow for even interpretation of an audit finding.
7) In response to the Audit Allocation section and its capabilities, the managers believed that it is a step in the right direction. They felt that the information provided in the model review section was useful and assisted with interpretation of the factors affecting an audit. They also felt that the allocation section would benefit if more factors were considered.
8) The auditor workload such as the number of audits scheduled for the auditor, should be included in Audit Allocation to allow better allocation of

auditors to audits. The managers suggested that WebSAT include a scheduling capability to accommodate this need.

9) The dominant feedback on the model review section was an appreciation for limiting the graphs' presentation to the parameters set in the Audit Impact and the Audit Allocation pages. The managers also appreciated that the Show All link gave them the opportunity to assess the outcome of other parameters by viewing all the graphs available.

8.2 Internal Audit

The following conclusions can be drawn based on the results of this research:

1) The auditors took significantly more time to make predictions using WebSAT without the model than using it with the model.
2) The auditors and manager were able to review and interpret the graphs in the model review section accurately.
3) The manager felt that more auditor and department related information need to be added to assist in the allocation.
4) The manager commented that the graphical section effectively illustrated model variables and their effect on response rate. This comment was supported by the results of the SUMI analysis.
5) The auditors considered the type of findings in previous audits and audit duration to be predictors of a department's performance. The manager believed that audit duration does not affect audit response rate.
6) The manager agreed with the model findings that the type of process measure affects the response rate.

8.3 Surveillance Module

The following conclusions can be drawn based on the results of this research:

1) The representatives took significantly more time to make predictions using WebSAT without the model than using it with the model. Thus, the tool reduced the time to predict vendor performance as well as the time for a manager to plan for a surveillance activity.
2) The representatives and managers were able to review and interpret the graphs in the model review section accurately. The representatives appreciated the contextual presentation of graphs to the parameters set in the Surveillance Planning pages.
3) There were mixed and conflicting opinions among the representatives on the effect of aircraft age, aircraft type, vendor location and process measures on rejection rate. The surveillance managers appeared to understand the effect of aircraft age, aircraft type, vendor location and process measures on rejection rate.
4) The representatives believed that the number of airlines a vendor does business with, the representative's experience and familiarity with different types of aircraft were additional candidates for predictor variables affecting vendor rejection rates.
5) To assign surveillance representatives to vendor locations using Surveillance Planning, mangers would require that a representative's experience, his familiarity with various fleet types and workload be available in the Surveillance Planning section.

8.4 Suggestions for Future Research and Recommendations

This research demonstrated the capability of a prediction and planning tool to support vendor and department assessment. However, this research was not fully integrated with the audit and surveillance process. It would be valuable to use weighted measures in a business support tool like WebSAT to evaluate the importance of audit and surveillance findings and facilitate its even interpretation. This work was based on the assumption that the auditing and surveillance process is consistent. However, as we have seen in the Discussion and Conclusion Chapters this is not so. Opportunity exists to standardize the auditing and surveillance process and the interpretation of its findings to allow for better models to be developed.

Further, this research was carried out with only one airline and with a small number of participants. Also, the data made available for this research was limited on account of confidentiality. Future studies might attempt to extend this evaluation to include more than one airline. The performance of the model in making predictions and planning might then be compared to the prediction and planning capabilities of another airline and its team of auditors, surveillance representatives and managers. It may then be possible to use a more rigorous between subject experimental design to assess the results. This would also lead the way towards developing a generic risk scale which allows an auditor to indicate the criticality of an audit or a finding.

This work was initiated in a small section of the airline's maintenance industry. Although information was collected from the auditors and surveillance representatives, this research did not involve the vendors who actually conducted the maintenance to understand their models and their similarity/difference to the surveillance representatives' and auditors model. This was made difficult in this

research partly due to the airline's requirement to maintain confidentiality of the information. Future research may focus on the feasibility of extending the use of historical data to include information on vendor characteristics. Further, Audit Allocation and Surveillance Planning tools would be of great value to the managers if more detailed information on auditor and surveillance characteristics and workload were provided. As an extension to this research, an evaluation of the effect of predictor variables on performance in the aviation industry can be applied to other environments such as hospitals and utility services.

8.5 Contributions of the Study

This research makes the following contributions in the field of model development for aviation audits and surveillance:

a) Models were developed for the airline's surveillance and auditing work functions.
b) A tool was developed which assists the auditor and surveillance representative in vendor performance prediction capabilities.
c) The airline may use this model within WebSAT to analyze maintenance data, thereby achieving higher safety levels.
d) The model results have enhanced the current knowledge of airline representatives regarding the effect of various variables on department and vendor performance. This has allowed the auditors, surveillance representatives and managers to make better decisions on vendor/ department performance.
e) Although the Audit Allocation and Surveillance Planning tools left more to be desired for, this research has indicated the need for collection and

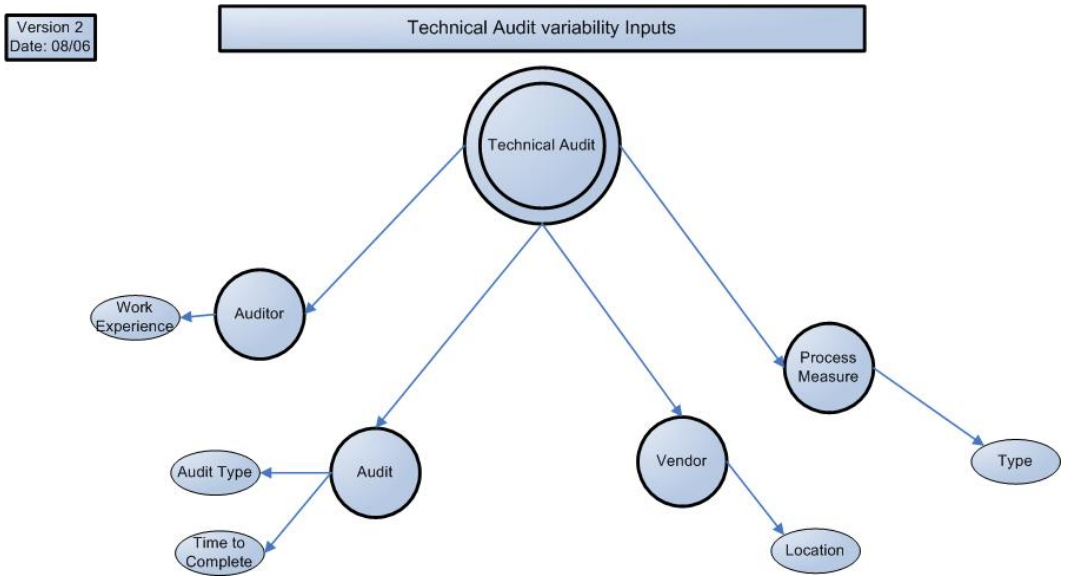
analysis of data on auditor, surveillance representative and vendor characteristics and workload.

f) Similar models can be created for other industries based on the methodology employed in this research.

APPENDICES

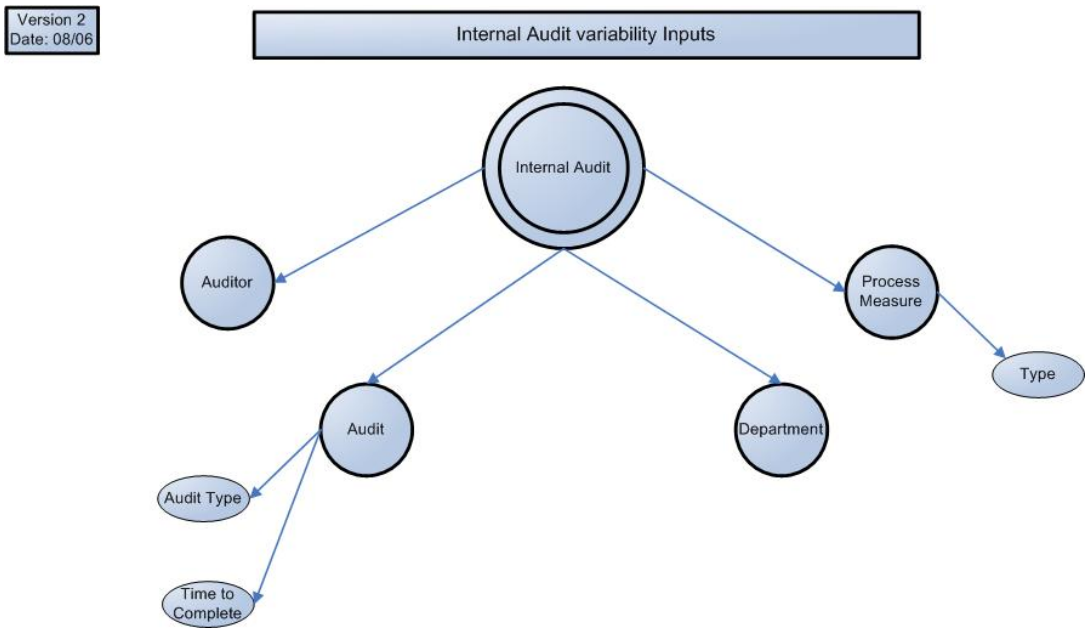
Appendix A

Technical Audit Variability



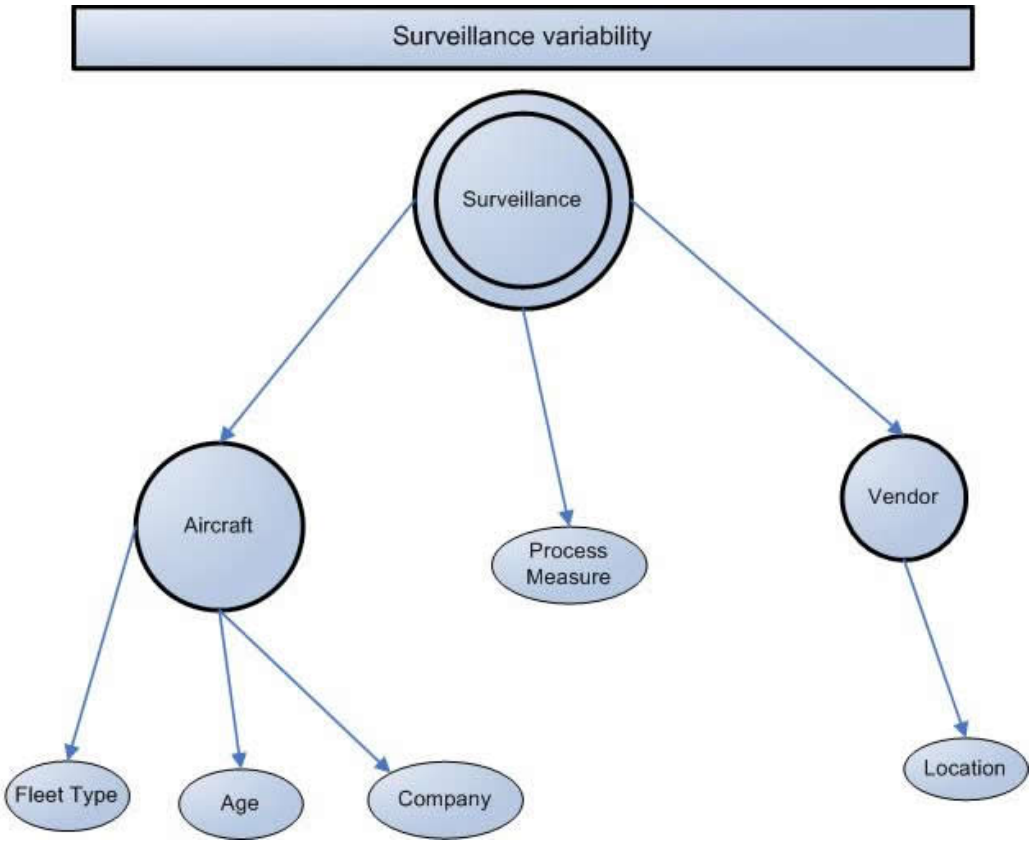
Appendix B

Internal Audit Variability



Appendix C

Surveillance Variability



Appendix D

Variable Hierarchy

Work Function	*Response Measure*	*Level 1*	*Level 2*
Technical Audit	"Yes"/ "No" responses to audit questions Process Measure	Audit Audit Type Audit Duration Auditor Auditor Experience	Vendor Name Continent
Internal Audit	"Yes"/ "No" responses to audit questions Process Measure	Audit Audit Duration	Auditor
Surveillance	"Accept"/ "Reject" to aircraft maintenance activity Process Measure	Aircraft Age Aircraft Type	Vendor Name Continent

Appendix E

Technical Audit Model – Significance

Type III Tests of Fixed Effects				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Aexpmean	1	14130	0.5	0.4815
Atypecode	3	14130	2.02	0.1092
Durationmean	1	14130	0.12	0.7309
Continent	2	14130	0.52	0.593
Processmeasure	6	14130	1.15	0.3315
Aexpmean*Atypecode	3	14130	0.71	0.5436
Aexpmean*Durationmean	1	14130	0.27	0.6034
Aexpmean*Continent	2	14130	8.22	0.0003
Aexpmean*Processmeas	6	14130	0.55	0.773
Durationmean*Atypecode	3	14130	5.87	0.0005
Durationmean*Continent	2	14130	10.8	<.0001
Durationmean*Processmeasure	6	14130	2.05	0.0559
Processmeasure*Continent	12	14130	0.93	0.5184
Aexpme*Durati*Proces	6	14130	1.61	0.1392
Aexp*Dura*Proc*Conti	14	14130	1.36	0.1622

Legend

Variable Name in SAS Code	**Variable Name**
Aexpmean	Auditor Experience
Atypecode	Audit Type
Durationmean	Audit Duration (mean centered)
Continent	Vendor Location by Continent
Processmeasure	Process Measure

Appendix F

Technical Audit Model – Estimates

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	4.5036	0.798	67	5.64	<.0001
Aexpmean	-0.1271	0.153	14130	-0.83	0.407
Atypecode1	0.7554	0.667	14130	1.13	0.257
Atypecode2	0.7864	0.390	14130	2.01	0.044
Atypecode3	0.2737	0.369	14130	0.74	0.458
Atypecode4	0	.	.	.	.
Durationmean	0.01617	0.012	14130	1.35	0.177
Continent1	-0.3099	0.852	14130	-0.36	0.716
Continent2	-0.2954	1.210	14130	-0.24	0.807
Continent3	0	.	.	.	.
Processmeasure1	-1.1267	0.780	14130	-1.44	0.148
Processmeasure2	-0.6561	0.890	14130	-0.74	0.461
Processmeasure3	-1.5978	0.777	14130	-2.06	0.039
Processmeasure4	-1.0197	0.870	14130	-1.17	0.241
Processmeasure5	-1.1374	0.768	14130	-1.48	0.138
Processmeasure6	-1.5834	0.817	14130	-1.94	0.052
Processmeasure7	0	.	.	.	.
Aexpmean*Atypecode1	0.2516	0.245	14130	1.02	0.305
Aexpmean*Atypecode2	-0.143	0.180	14130	-0.79	0.428
Aexpmean*Atypecode3	-0.0746	0.179	14130	-0.42	0.678
Aexpmean*Atypecode4	0	.	.	.	.
Aexpmean*Durationmea	0.00859	0.0032	14130	2.63	0.008
Aexpmean*Continent1	0.2657	0.120	14130	2.21	0.027
Aexpmean*Continent2	-0.1889	0.166	14130	-1.14	0.256
Aexpmean*Continent3	0	.	.	.	.
Aexpmean*Processmeas1	-0.0169	0.102	14130	-0.16	0.869
Aexpmean*Processmeas2	-0.068	0.135	14130	-0.5	0.615
Aexpmean*Processmeas3	0.03008	0.106	14130	0.28	0.777
Aexpmean*Processmeas4	0.07707	0.109	14130	0.7	0.481
Aexpmean*Processmeas5	0.00463	0.102	14130	0.05	0.963
Aexpmean*Processmeas6	0.0317	0.119	14130	0.27	0.79
Aexpmean*Processmeas7	0	.	.	.	.
Durationme*Atypecode1	-0.0085	0.038	14130	-0.22	0.826
Durationme*Atypecode2	0.05705	0.013	14130	4.12	<.0001
Durationme*Atypecode3	0.02821	0.009	14130	2.87	0.004
Durationme*Atypecode4	0	.	.	.	.
Durationme*Continent1	-0.0367	0.0079	14130	-4.64	<.0001

Durationme*Continent2	-0.019	0.020	14130	-0.93	0.352
Durationme*Continent3	0	.	.	.	.
Durationm*Processmea1	-0.0101	0.011	14130	-0.85	0.398
Durationm*Processmea2	-0.0268	0.013	14130	-1.93	0.054
Durationm*Processmea3	-0.0022	0.012	14130	-0.18	0.860
Durationm*Processmea4	-0.0107	0.012	14130	-0.86	0.392
Durationm*Processmea5	-0.0137	0.011	14130	-1.16	0.247
Durationm*Processmea6	-0.0249	0.012	14130	-1.92	0.055
Durationm*Processmea7	0	.	.	.	.
Processmea1*Continent1	0.1667	0.831	14130	0.2	0.841
Processmea1*Continent2	0.5459	1.224	14130	0.45	0.655
Processmea1*Continent3	0	.	.	.	.
Processmea2*Continent1	-0.2678	0.955	14130	-0.28	0.779
Processmea2*Continent2	3.5164	6.141	14130	0.57	0.566
Processmea2*Continent3	0	.	.	.	.
Processmea3*Continent1	0.8322	0.835	14130	1	0.319
Processmea3*Continent2	1.3364	1.241	14130	1.08	0.281
Processmea3*Continent3	0	.	.	.	.
Processmea4*Continent1	0.05284	0.925	14130	0.06	0.954
Processmea4*Continent2	-0.0393	1.303	14130	-0.03	0.976
Processmea4*Continent3	0	.	.	.	.
Processmea5*Continent1	0.6143	0.818	14130	0.75	0.453
Processmea5*Continent2	0.4139	1.148	14130	0.36	0.718
Processmea5*Continent3	0	.	.	.	.
Processmea6*Continent1	0.6483	0.891	14130	0.73	0.466
Processmea6*Continent2	3.5976	2.385	14130	1.51	0.131
Processmea6*Continent3	0	.	.	.	.
Processmea7*Continent1	0	.	.	.	.
Processmea7*Continent2	0	.	.	.	.
Processmea7*Continent3	0	.	.	.	.
Aexpme*Durati*Proces1	-0.0057	0.0031	14130	-1.79	0.072
Aexpme*Durati*Proces2	-0.0084	0.0037	14130	-2.25	0.024
Aexpme*Durati*Proces3	-0.0033	0.0033	14130	-0.99	0.323
Aexpme*Durati*Proces4	-0.0047	0.003	14130	-1.41	0.158
Aexpme*Durati*Proces5	-0.006	0.0031	14130	-1.93	0.053
Aexpme*Durati*Proces6	-0.0078	0.0034	14130	-2.28	0.022
Aexpme*Durati*Proces7	0	.	.	.	.
Aexp*Dura*Proc1*Conti1	-0.0021	0.0033	14130	-0.62	0.533
Aexp*Dura*Proc1*Conti2	0.02609	0.015	14130	1.71	0.086
Aexp*Dura*Proc1*Conti3	0	.	.	.	.
Aexp*Dura*Proc2*Conti1	0.00529	0.005	14130	0.94	0.345
Aexp*Dura*Proc2*Conti2	-0.0717	0.139	14130	-0.51	0.607
Aexp*Dura*Proc2*Conti3	0	.	.	.	.
Aexp*Dura*Proc3*Conti1	-0.0066	0.0040	14130	-1.62	0.105
Aexp*Dura*Proc3*Conti2	-0.0195	0.017	14130	-1.14	0.254

Aexp*Dura*Proc3*Conti3	0	.	.	.	.
Aexp*Dura*Proc4*Conti1	-0.0091	0.0043	14130	-2.12	0.034
Aexp*Dura*Proc4*Conti2	0.00184	0.015	14130	0.12	0.906
Aexp*Dura*Proc4*Conti3	0	.	.	.	.
Aexp*Dura*Proc5*Conti1	-0.0041	0.0033	14130	-1.21	0.226
Aexp*Dura*Proc5*Conti2	0.00229	0.011	14130	0.2	0.840
Aexp*Dura*Proc5*Conti3	0	.	.	.	.
Aexp*Dura*Proc6*Conti1	-0.0003	0.0045	14130	-0.06	0.953
Aexp*Dura*Proc6*Conti2	0.07723	0.039	14130	1.96	0.050
Aexp*Dura*Proc6*Conti3	0	.	.	.	.
Aexp*Dura*Proc7*Conti1	-0.0122	0.0079	14130	-1.53	0.125
Aexp*Dura*Proc7*Conti2	-0.0223	0.024	14130	-0.91	0.361
Aexp*Dura*Proc7*Conti3	0	.	.	.	

Legend

Variable Name in SAS Code	**Variable Code Levels**	**Variable Level Names**
Atypecode	Atypecode1	Fuel
	Atypecode2	Line
	Atypecode3	Ramp Operations
	Atypecode4	Suppliers
Continent	Continent1	America
	Continent2	Asia
	Continent3	Europe
Processmeasure	Processmeasure1	Compliance and Documentation
	Processmeasure2	Inspection
	Processmeasure3	Facility Control
	Processmeasure4	Employee Training
	Processmeasure5	Procedures
	Processmeasure6	Data Control
	Processmeasure7	Safety
Aexpmean	-	Auditor Experience (mean centered)
Durationmean	-	Audit Duration (mean centered)

Appendix G

Technical Audit Model

Y = 4.5036

+ Aexpmean(-0.1271) + (0.7554)Atypecode1 + (0.7864)Atypecode2 +

(0.2737)Atypecode3 +(0)Atypecode4 + (0.01617) Durationmean + (-

0.3099)Continent1 + (-0.2954)Continent2 + (0)Continent3 + (-

1.1267)Processmeasure1 + (-0.6561)Processmeasure2 + (-1.5978)

Processmeasure3 + (-1.0197)Processmeasure4 + (-1.1374)Processmeasure5 + (-

1.5834) Processmeasure6 + (0)Processmeasure7 + (0.2516)Aexpmean*Atypecode1

+ (-0.143) Aexpmean*Atypecode2 + (-0.0746)Aexpmean*Atypecode3 +

(0)Aexpmean*Atypecode4 + (0.008586) Aexpmean*Durationmean +

(0.2657)Aexpmean*Continent1 + (-0.1889) Aexpmean * Continent2 +

(0)Aexpmean*Continent3 + (-0.01689)Aexpmean*Processmeasure1 + (-

0.06798)Aexpmean*Processmeasure2 + (0.03008)Aexpmean*Processmeasure3 +

(0.07707) Aexpmean *Processmeasure4 + (0.00463)Aexpmean*Processmeasure5 +

(0.0317) Aexpmean * Processmeasure6 + (0)Aexpmean*Processmeasure7 + (-

0.00847)Durationmean*Atypecode1 + (0.05705) Durationmean*Atypecode2 +

(0.02821)Durationmean*Atypecode3 + (0) Durationmean *Atypecode4 + (-0.0367)

Durationmean*Continent1 + (-0.01904) Durationmean * Continent2 +

(0)Durationmean*Continent3

Legend

Variable Name in SAS Code	Variable Code Levels	Variable Level Names
Atypecode	Atypecode1	Fuel
	Atypecode2	Line
	Atypecode3	Ramp Operations
	Atypecode4	Suppliers
Continent	Continent1	America
	Continent2	Asia
	Continent3	Europe
Processmeasure	Processmeasure1	Compliance and Documentation
	Processmeasure2	Inspection
	Processmeasure3	Facility Control
	Processmeasure4	Employee Training
	Processmeasure5	Procedures
	Processmeasure6	Data Control
	Processmeasure7	Safety
Aexpmean	-	Auditor Experience (mean centered)
Durationmean	-	Audit Duration (mean centered)

Appendix H

Internal Audit Model- Significance

Type III Tests of Fixed Effects				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Durationmean	1	1420	0.18	0.6677
Processmeasure	5	1420	4.07	0.0011

Legend

Variable Name in SAS Code	**Variable Name**
Durationmean	Audit Duration (mean centered)
Processmeasure	Process Measure

Appendix I

Internal Audit Model- Estimates

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	2.8498	0.5118	2	5.57	0.0308
Durationmean	-0.00099	0.002307	1420	-0.43	0.6677
Processmeasure1	-0.7723	0.4461	1420	-1.73	0.0836
Processmeasure2	-1.3294	0.5152	1420	-2.58	0.0100
Processmeasure3	-0.2957	0.4430	1420	-0.67	0.5045
Processmeasure4	0.9081	1.1045	1420	0.82	0.4111
Processmeasure5	0.2872	0.7332	1420	0.39	0.6954
Processmeasure6	0	.	.	.	.

Legend

Variable Name Code	Variable Code Levels	Variable Level Names
Processmeasure	Processmeasure1	Administration
	Processmeasure2	Inspection
	Processmeasure3	Facility Control
	Processmeasure4	Employee Training
	Processmeasure5	Procedures
	Processmeasure6	Data Control
Durationmean	-	Audit Duration (mean centered)

Appendix J

Internal Audit Model

Y = 2.8498 + (-0.7723) Processmeasure1 + (-1.3294) Processmeasure2 + (-0.2957) Processmeasure3 + (0.9081) Processmeasure4 + (0.2872) Processmeasure5 + (0) Processmeasure6

Legend

Variable Name Code	**Variable Code Levels**	**Variable Level Names**
Processmeasure	Processmeasure1	Administration
	Processmeasure2	Inspection
	Processmeasure3	Facility Control
	Processmeasure4	Employee Training
	Processmeasure5	Procedures
	Processmeasure6	Data Control
Durationmean	-	Audit Duration (mean centered)

Appendix K

Surveillance Model- Significance

Type III Tests of Fixed Effects				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Contcode	2	82122	2.72	0.0661
Aircraftmodelcode	7	82122	30.98	<.0001
Aircraftagemean	1	82122	32.3	<.0001
PM	5	82122	589.47	<.0001
PM*Contcode	10	82122	34.1	<.0001
Aircraftagemean*PM	5	82122	17.6	<.0001
Aircraftage*Contcode	2	82122	22.6	<.0001

Legend

Variable Name in SAS Code	**Variable Name**
Aircraftmodelcode	Aircraft Types
Contcode	Continent for Vendor Location
PM	Process Measure
Aircraftagemean	Aircraft Age (mean centered)

Appendix L

Surveillance Model- Estimates

Solution for Fixed Effects – Parameter Estimates					
Effect	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
Intercept	-1.256	0.5177	11	-2.43	0.0336
Contcode1	2.1027	0.616	82122	3.41	0.0006
Contcode2	2.3991	0.672	82122	3.57	0.0004
Contcode3	0	.	.	.	.
Aircraftmodelcode1	0.2728	0.1175	82122	2.32	0.0203
Aircraftmodelcode2	0.5993	0.1227	82122	4.88	<.0001
Aircraftmodelcode3	0.1525	0.09283	82122	1.64	0.1003
Aircraftmodelcode4	0.7824	0.1289	82122	6.07	<.0001
Aircraftmodelcode5	0.6961	0.1162	82122	5.99	<.0001
Aircraftmodelcode6	1.2211	0.1277	82122	9.56	<.0001
Aircraftmodelcode7	0.195	0.1062	82122	1.84	0.0662
Aircraftmodelcode8	0	.	.	.	.
Aircraftagemean	-0.07671	0.0145	82122	-5.29	<.0001
PM1	2.7094	0.1574	82122	17.21	<.0001
PM2	3.1439	0.1307	82122	24.06	<.0001
PM3	2.2115	0.3921	82122	5.64	<.0001
PM4	1.4804	0.1052	82122	14.07	<.0001
PM5	0.5365	0.1266	82122	4.24	<.0001
PM6	0	.	.	.	.
PM1*Contcode1	-0.4513	0.1942	82122	-2.32	0.0201
PM1*Contcode2	-0.9203	0.2187	82122	-4.21	<.0001
PM1*Contcode3	0	.	.	.	.
PM2*Contcode1	-1.6839	0.1621	82122	-10.39	<.0001
PM2*Contcode2	-1.2754	0.1808	82122	-7.05	<.0001
PM2*Contcode3	0	.	.	.	.
PM3*Contcode1	-2.0366	0.4282	82122	-4.76	<.0001
PM3*Contcode2	-1.048	0.4492	82122	-2.33	0.0196
PM3*Contcode3	0	.	.	.	.

PM4*Contcode1	-0.5775	0.1402	82122	-4.12	<.0001
PM4*Contcode2	-1.1577	0.1549	82122	-7.48	<.0001
PM4*Contcode3	0	.	.	.	.
PM5*Contcode1	-0.5775	0.1749	82122	-3.3	0.001
PM5*Contcode2	-1.1921	0.1844	82122	-6.47	<.0001
PM5*Contcode3	0	.	.	.	.
PM6*Contcode1	0	.	.	.	.
PM6*Contcode2	0	.	.	.	.
PM6*Contcode3	0	.	.	.	.
Aircraftagemean*PM1	0.01367	0.009144	82122	1.5	0.1348
Aircraftagemean*PM2	-0.00985	0.007572	82122	-1.3	0.1935
Aircraftagemean*PM3	-0.04232	0.01443	82122	-2.93	0.0034
Aircraftagemean*PM4	0.02545	0.007259	82122	3.51	0.0005
Aircraftagemean*PM5	-0.00388	0.008983	82122	-0.43	0.6659
Aircraftagemean*PM6	0	.	.	.	.
Aircraftage*Contcode1	0.06065	0.01437	82122	4.22	<.0001

Legend

Variable Name in SAS Code	**Variable Code Levels**	**Variable Level Names**
Aircraftmodelcode	Aircraftmodelcode1	Boeing 727
	Aircraftmodelcode2	Airbus 300
	Aircraftmodelcode3	Airbus 310
	Aircraftmodelcode4	MD 10 30F
	Aircraftmodelcode5	MD 10 10F
	Aircraftmodelcode6	MD 11 11F
	Aircraftmodelcode7	Fokker F27
	Aircraftmodelcode8	Cessna 208
Contcode	Contcode1	America
	Contcode2	Europe
	Contcode3	Asia
PM	PM1	In Process Surveillance
	PM2	Verification Surveillance
	PM3	Final Walkaround
	PM4	Documentation Surveillance
	PM5	Facility Walkaround
	PM6	Procedure Manual Violation
Aircraftagemean	-	Aircraft Age (mean centered)

Appendix M

Surveillance Model

Y = -1.256

+ (-2.1027) Continent1 + (-2.3991) Continent2 + (0) Continent3

+ (-0.2728) Aircraftmodelcode1 + (-0.5993) Aircraftmodelcode2 + (-0.1525) Aircraftmodelcode3 + (-0.7824) Aircraftmodelcode4 + (-0.6961) Aircraftmodelcode5

+ (-1.2211) Aircraftmodelcode6 + (-0.195) Aircraftmodelcode7 + (0) Aircraftmodelcode8

+ (-0.07671) Aircraftage

+ (-2.7094) Processmeasure1 + (-3.1439) Processmeasure2 + (-2.2115) Processmeasure3 + (-1.4804) Processmeasure4 + (-0.5365) Processmeasure5 + (0) Processmeasure6

+ (-0.4513) Processmeasure1*Continent1 + (-0.9203) Processmeasure1*Continent2

+ (0) Processmeasure1*Continent3

+ (-1.6839) Processmeasure2*Continent1 + (-1.2754) Processmeasure2*Continent2

+ (0) Processmeasure2*Continent3

+ (-2.0366) Processmeasure3*Continent1 + (-1.048) Processmeasure3*Continent2

+ (0) Processmeasure3*Continent3

+ (-0.5775) Processmeasure4*Continent1 + (-1.1577) Processmeasure4*Continent2

+ (0 Processmeasure4*Continent3

+ (-0.5775) Processmeasure5*Continent1 + (-1.1921) Processmeasure5*Continent2

+ (0) Processmeasure5*Continent3+ (0) Processmeasure6*Continent1 + (0) Processmeasure6*Continent2+ (0) Processmeasure6*Continent3

+ (-0.01367) Aircraftage*Processmeasure1 + (-0.00985) Aircraftage

*Processmeasure2 + (-0.04232) Aircraftage*Processmeasure3 + (-0.02545)

Aircraftage*Processmeasure4

+ (-0.00388) Aircraftage*Processmeasure5 + (0) Aircraftage*Processmeasure6

+ (-0.06065) Aircraftage*Continent1 + (-0.08267) Aircraftage*Continent2

+ (0) Aircraftage*Continent3

Legend

Variable Name in SAS Code	**Variable Code Levels**	**Variable Level Names**
Aircraftmodelcode	Aircraftmodelcode1	Boeing 727
	Aircraftmodelcode2	Airbus 300
	Aircraftmodelcode3	Airbus 310
	Aircraftmodelcode4	MD 10 30F
	Aircraftmodelcode5	MD 10 10F
	Aircraftmodelcode6	MD 11 11F
	Aircraftmodelcode7	Fokker F27
	Aircraftmodelcode8	Cessna 208
Contcode	Contcode1	America
	Contcode2	Europe
	Contcode3	Asia
PM	PM1	In Process Surveillance
	PM2	Verification Surveillance
	PM3	Final Walkaround
	PM4	Documentation Surveillance
	PM5	Facility Walkaround
	PM6	Procedure Manual Violation
Aircraftagemean	-	Aircraft Age (mean centered)

Appendix N

Needs Rating

Need #	Need	TAM	IAM	SM 1	SM 2	FR
1	The tool identifies the source of risk factors to the aircraft.	NA	NA	5	5	5
2	The tool presents information which will benefit the QAR.	NA	NA	5	5	5
3	The tool indicates the potential risk to the aircraft because of technical audit findings.	5	NA	NA	NA	5
4	The tool recommends information for future technical audits.	5	NA	NA	NA	5
5	The tool allows the internal auditor to view discrepancies which impact the aircraft safety.	NA	5	NA	NA	5
6	The tool has the ability to indicate potentially problematic areas in an internal audit.	NA	5	NA	NA	5
7	The tool has the ability to report critical findings for internal audits at a managerial level.	NA	5	NA	NA	5

WebSAT Needs Importance Ratings Survey

1. Need is undesirable. I would not consider a product with this need.
2. Need is not important but I would not mind having it.
3. Need would be nice to have but is not necessary.
4. Need is highly desirable but I would consider a product without it.
5. Need is critical. I would not consider a product without this need.

Legend
TAM: Rating of the technical audits manager
IAM: Rating of the internal audits manager
SM 1: Rating of the first surveillance manager
SM 2: Rating of the second surveillance manager
FR: Final average rating
NA: Not Applicable

Appendix O

Feedback Questionnaire (With/without model)

The following criteria relate to the tasks you just completed using WebSAT. Using a scale of 1 through 7, rate WebSAT with respect to these criteria as accurately as possible.

Note: A rating of 7 would imply that the system satisfied the criterion completely and a rating of 1 would imply that the system barely satisfied the criterion.

(A) **Ability to generate useful information for future maintenance and audits.**

#	Criteria	Rating
1.	Easy retrieval of audit/ surveillance information	
2.	Availability of important audit/surveillance information	
3.	Reduction of non-value-added activities during audit/surveillance information review	
4.	Ability to predict response / rejection rates	
5.	Ability to assess risk factors and their impact	
6.	Ability to view historical information graphically	

Comments:

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_____

_____

Appendix P

Sample Data Distribution- Technical Audit

Descriptive Statistics for Continuous Variables - Audit Duration and Auditor

"All" Refers to historical data

Experience

	N		Mean		Std. Deviation	
	All	Sample	All	Sample	All	Sample
Duration (Days)	18,666	4,369	32.31	30.13	30.033	23.499
Auditor Experience (Years)	18,666	4,369	7.467	9.379	6.9012	13.6946

Frequency Distribution for Categorical Variables

(a) Audit Type

	Frequency		Percent	
	All	Sample	All	Sample
Fuel	1,651	444	8.8	10.2
Line	2,716	760	14.6	17.4
Ramp	2,665	716	14.3	16.4
Suppliers	11,632	2,449	62.3	56.1
Total	18,664	4,369	100.0	100.0

(b) Continents

	Frequency		Percent	
	All	Sample	All	Sample
America	14,501	3,146	77.7	72.0
Asia	1,813	528	9.7	12.1
Europe	2,350	695	12.6	15.9
Total	18,664	4,369	100.0	100.0

(c) Process Measures

	Frequency		Percent	
	All	Sample	All	Sample
Compliance and Documentation	3,806	872	20.4	20.0
Inspection	1,490	352	8.0	8.1
Facility Control	2,554	584	13.7	13.4
Training and Personnel	1,572	377	8.4	8.6
Procedures	5,902	1,395	31.6	31.9
Data Control	1,823	424	9.8	9.7
Safety	1,517	365	8.0	8.4
Total	18,664	4,369	100.0	100.0

(d) Responses

	Frequency		Percent	
	All	Sample	All	Sample
No	3,334	866	17.9	19.8
Yes	15,330	3,503	82.1	80.2
Total	18,664	4,369	100.0	100.0

Appendix Q

Sample Data Distribution - Internal Audit

Descriptive Statistics for Continuous Variables - Audit Duration

"All" Refers to historical data

	N		Mean		Std. Deviation	
	All	Sample	All	Sample	All	Sample
Duration	5,218	769	54.90	57.83	47.716	52.102

Frequency Distribution for Categorical Variables

(a) Audit Type

	Frequency		Percent	
	All	Sample	All	Sample
Engineering Maintenance and Materials	2,831	412	54.2	53.6
Flight Operations	2,388	357	45.8	46.4
Total	5,219	769	100.0	100.0

(b) Department

	Frequency		Percent	
	All	Sample	All	Sample
Air Flight Management	35	3	0.7	0.4
Air Charter Program	63	7	1.2	0.9
Air Navigation Dept.	51	7	1.0	0.9
Air Traffic Operations	113	12	2.2	1.6
Aircraft Charter Program	47	7	0.9	0.9
AOD Material	50	11	1.0	1.4
Acquisitions	53	11	1.0	1.4
Aviation Resource	108	14	2.1	1.8
ARD	48	7	0.9	0.9
Air Safety	30	5	0.6	0.7
Avionics	84	11	1.6	1.4
Charter Operations	42	6	0.8	0.8
Chief Pilot IEP	83	13	1.6	1.7

CR & S	89	13	1.7	1.7
Crew Planning	28	5	0.5	0.7
Crew Resource Scheduling	143	20	2.7	2.6
Crew Transportation	60	8	1.1	1.0
Director of Operations	111	22	2.1	2.9
Engineering	85	10	1.6	1.3
FAA Liason	20	2	0.4	0.3
Ferry & Flight Test	44	7	0.8	0.9
Fleet Conversions	34	3	0.7	0.4
Flight Coordination	133	20	2.5	2.6
Flight Safety	119	14	2.3	1.8
Flight Safety Audit	141	25	2.7	3.3
Flight Services	221	40	4.2	5.2
Flight Standards	204	23	3.9	3.0
Flight Test	73	9	1.4	1.2
Flight Training	49	8	0.9	1.0
Flight Training Schedule	44	7	0.8	0.9
GOCC	316	48	6.1	6.2
Hangar 10	219	31	4.2	4.0
Indiana Base Maintenance	326	45	6.2	5.9
Jumpseat Operations	38	8	0.7	1.0
LAX Base Maintenance	465	57	8.9	7.4
LAX NDT Internal C/L	53	5	1.0	0.7
MEM Avionics Shop	106	12	2.0	1.6
Memphis Base Maintenance	447	76	8.6	9.9
Memphis Stores	23	2	0.4	0.3
Memphis Warehouse	66	10	1.3	1.3
MOCC	103	23	2.0	3.0
Maintenance Programs	54	10	1.0	1.3
Maintenance Technical Training	40	4	0.8	0.5
Maintenance Training	36	9	0.7	1.2
Powerplant Prod Control	30	6	0.6	0.8
Powerplant Shop	71	12	1.4	1.6
QA ADCG	38	5	0.7	0.7
QA FMR	25	5	0.5	0.7
QA On-site	26	7	0.5	0.9
QA On-Site	20	2	0.4	0.3
QA ROV	23	7	0.4	0.9
Reliability	40	5	0.8	0.7

Seat Shop	32	0	0.6	
Tech. Publications	64	6	1.2	0.8
Vendor Management	25	3	0.5	0.4
Weather	54	6	1.0	0.8
Weather Department Audit	39	10	0.7	1.3
Weather Services	35	5	0.7	0.7
Total	5,219	769	100.0	100.0

(c) Process Measure

	Frequency		Percent	
	All	Sample	All	Sample
Administration	529	70	10.1	9.1
Inspection	89	9	1.7	1.2
Facility Control	895	143	17.1	18.6
Employee Training	40	8	0.8	1.0
Procedures	71	9	1.4	1.2
Data Control	101	12	1.9	1.6
Total	1,725	769	33.1	32.6

(d) Responses

	Frequency		Percent	
	All	Sample	All	Sample
No	769	107	14.7	13.9
Yes	4,450	662	85.3	86.1
Total	5,219	769	100.0	100.0

Appendix R

Sample Data Distribution - Surveillance

Descriptive Statistics for Continuous Variables - Aircraft Age

"All" Refers to historical data

	N		Mean		Std. Deviation	
	All	Sample	All	Sample	All	Sample
Aircraft Age	82,857	742	23.72	23.90	8.315	8.010

Frequency Distribution for Categorical Variables

(a) Process Measures

	Frequency		Percent	
	All	Sample	All	Sample
In Process	15,090	172	18.2	17.9
Verification	32,959	390	39.8	40.7
Final Walkaround	1,302	21	1.6	2.2
Documentation Surveillance	24,100	245	29.1	25.5
Facility Surveillance	3,934	51	4.7	5.3
Procedures Manuals Violations	5472	80	6.7	8.3
Total	82,857	959	100.0	100.0

(b) Continents

	Frequency		Percent	
	All	Sample	All	Sample
America	45,452	540	54.9	56.3
Europe	21,730	239	26.2	24.9
Asia	15,675	180	18.9	18.8
Total	82,857	959	100.0	100.0

(c) Aircraft Model

	Frequency		Percent	
	All	Sample	All	Sample
Boeing 727	20,508	248	24.8	25.9
Airbus 300	5,360	61	6.5	6.4
Airbus 310	11,132	135	13.4	14.1
MD 10 30 F	3,767	52	4.5	5.4
MD 10 10 F	20,583	242	24.8	25.2
MD 11F	14,766	125	17.8	13.0
Fokker 27	2,966	37	3.6	3.9
Cessna 208	3,775	59	4.6	6.2
Total	82,857	959	100.0	100.0

(d) Responses

	Frequency		Percent	
	All	Sample	All	Sample
Reject	8,193	124	9.9	12.9
Accept	74,664	835	90.1	87.1
Total	82,857	959	100.0	100.0

Appendix S

IRB Informed Consent Form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

User Testing of an Intranet Application (Web-based Surveillance and Auditing Tool (WebSAT)) to Evaluate the Performance of the Interface

Study to be conducted at:	**Memphis, TN, Mobile, AL, and Greensboro, NC**
Principal Investigator:	**Dr. Anand Gramopadhye 864-656-5540**
Co-Investigator:	**Dr. Joel Greenstein 864-656-5649**
Research Assistant:	**Kunal Kapoor 864-656-7891**
Research Assistant:	**Nikhil Iyengar 864-656-7891**
Research Assistant:	**Pallavi Dharwada 864-656-7891**

INFORMATION:

You are invited to participate in a research study. Before you choose to be a research participant, it is important that you read the following information and ask as many questions as necessary to be sure that you understand what your participation will involve. Your signature on this consent form will acknowledge that you received all of the following information and explanations from the investigators, and have been given an opportunity to discuss your questions and concerns with these investigators.

PURPOSE:

You are invited to participate in an experiment aimed to evaluate the performance of the WebSAT application. The purpose of this session is to investigate the performance of WebSAT interfaces with respect to their functionality, screen content and ease of use. If you participate, you will be required to perform certain scenarios representative of the functionality of the prototype as a part of reviewing the screens. You will work individually. Your participation will involve one session, which will last approximately one hour. If you participate, you will be one of approximately 24 people who will be participating in this session.

POSSIBLE RISKS:

There are no known risks associated with this research.

POTENTIAL BENEFITS:

The results obtained through your participation in this study will help us to evaluate the use of WebSAT application in your surveillance and auditing work domain.

This form is valid only if the
Clemson University IRB
stamp of approval is shown here:

Revised: June 2005

VOLUNTARY PARTICIPATION:
Participation in this study is voluntary. You may refuse to participate or withdraw from the study at any time. If you refuse to participate or withdraw from the study at any time, you will not be penalized or lose any benefits and your decision will not affect your relationship with this organization.

CONFIDENTIALITY:
The records of your participation are confidential. The investigator will maintain your information, and this information may be kept on a computer. However, the data on your participation will be available only to the investigators. This study may be used to make presentations, but your identity will not be revealed.

CONTACT INFORMATION:
If you have any questions or concerns about this study or if any problems arise, please contact (Dr. Anand K. Gramopadhye, the Principal Investigator) at Clemson University at 864.656.5540. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Institutional Review Board at 864.656.6460.

CONSENT
I have been given an opportunity to ask questions about this study; answers to such questions (if any) have been satisfactory.

In consideration of all of the above, I give my consent to participate in this research study. I acknowledge receipt of a copy of this informed consent statement.

PARTICIPANT'S SIGNATURE: _____ DATE: _____

This form is valid only if the
Clemson University IRB
stamp of approval is shown here:

Revised: June 2005

Appendix T

Task Sheet- Technical Auditor

Introduction:

You will be reviewing and evaluating the utility and planning capability of the prediction model in the Web-based surveillance and auditing tool (WebSAT). This tool will allow you to store audit data, generate reports on stored data and conduct analysis using this data. The prediction model in this tool uses a statistical approach to analyze and interpret the historical data that was provided to us. This model can predict the response rate of an audit task. Response rate is the percentage of "Yes" responses received in an audit.

- The time for each session is about 1 hour.
- In this session, you will conduct two tests: Test I and Test II.
- Test I will contain six tasks and Test II will contain seven tasks.
- You will perform the same tasks for both the tests.
- Each task will require you to review preliminary data on an audit and its vendor. The tests will require you to review the vendor's history in WebSAT. The information to perform the task using this preliminary data will be provided in this task sheet.
- In Test I, you will be asked to predict a response rate at the end of each task. In one of the six tasks, you will be given five sub-tasks. In Test II, two of the seven tasks will ask you to predict a response rate using the available model within the WebSAT tool.
- You will be asked to complete a questionnaire to rate your satisfaction with the tool.

This session will assess the utility of the prediction model in WebSAT for end users such as auditors like you. You will be asked to "think-aloud," basically describing what you are doing, why you are doing it, and what you expect to happen while you are doing it. If you are having trouble with this, your observer will help by prompting you with appropriate questions when necessary.

I want you to remember that it is the tool that we are testing, and not you.

Keep in mind: Your opinion matters!

Do you have any questions at this point?

TEST I >>> Task 1

You are "Auditor_10 Sanson" with userid **and** password "asanson" and with ***10 years*** of experience. You have been told to conduct a ***Fuel*** Audit on Vendor Buffalo located in Buffalo, NY on the ***American*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Now, assume that

- You have traveled to Buffalo, NY on the American continent and conducted the audit.
- It took you ***10 days*** to complete this audit.

[Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 2

You are "Auditor_10 Sanson" with ***10 years*** of experience. You have been told to conduct a ***Line Audit*** on Vendor NRT located in Narita, Japan on the ***Asian*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Narita, Japan on the Asian continent and conducted the audit.
- It took you ***10 days*** to complete this audit.

[Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 3

You are "Thomas Wilson" with **15 years** *of experience* (userid and password - thomasw). You have been told to conduct a ***Supplier*** Audit on Vendor Avionics and Simulation for Airbus France located in Cedex, France on the European continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Cedex, France on the European continent and conducted the audit.
- It took you ***20 days*** to complete this audit.

[Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 4

You are "Judy Smith" with **2 years** *of experience* (userid and password -judyg). You have been told to conduct a ***Ramp*** Audit on Vendor FWA located in Fort Wayne, IN on the ***American*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Fort Wayne, IN on the American continent and conducted the audit.
- It took you ***30 days*** to complete this audit.

[Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 5

You are "Judy Smith" with **2 years** *of experience.* You have been told to conduct a ***Line Audit*** on Vendor EWR located in Newark, NJ on the ***American*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Newark, NJ on the American continent and conducted the audit.
- It took you ***20 days*** to complete this audit.

[Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 6

Assume a base case that you are "Judy Guinn" *with* **2 years** *of experience*. You have been told to conduct a ***Line Audit*** on Vendor EWR located in Newark, NJ on the ***American*** continent. Assume that you have traveled to Newark, NJ on the American continent and conducted the audit and it took you ***20 days*** to complete this audit.

You predicted a response rate of _____ for this audit.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting a **Supplier Audit** (instead of a Line Audit) on Vendor EWR. It takes you ***20 days*** to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 2

Assume everything else from the base case remains the same. However, it takes you **35 days** (instead of 20 days) to complete the ***Line Audit*** on Vendor EWR.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 3

Assume everything else from the base case remains the same. However, another auditor, ***Sanson***, was sent to conduct the ***Line Audit***, instead of you, on Vendor EWR. This auditor has **10 years experience** (instead of 2 years). It took him ***20 days*** to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 4

Assume everything else from the base case remains the same. However, it takes you **15 days** (instead of 20 days) to complete the ***Line Audit*** on Vendor EWR.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting a ***Line Audit*** on Vendor EWR located in **Brussels on the European continent** (instead of the American continent). It took you ***20 days*** to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST II >>> Task 1

You are "Auditor_10 Sanson" with ***10 years*** of experience. You have been told to conduct a ***Fuel*** Audit on Vendor Buffalo located in Buffalo, NY on the ***American*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Now, assume that

- You have traveled to Buffalo, NY on the American continent and conducted the audit.
- It took you ***10 days*** to complete this audit.

[Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 2

You are "Auditor_10 Sanson" with ***10 years*** of experience. You have been told to conduct a ***Line*** Audit on Vendor NRT located in Narita, Japan on the ***Asian*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Narita, Japan on the Asian continent and conducted the audit.
- It took you ***10 days*** to complete this audit.

[Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 3

You are "Thomas Wilson" with **15 years** *of experience.* You have been told to conduct a ***Supplier*** Audit on Vendor Avionics and Simulation for Airbus France located in Cedex, France on the European continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Cedex, France on the European continent and conducted the audit. It took you ***20 days*** to complete this audit.
-

[Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 4

You are "Judy Smith" with **2 years** *of experience.* You have been told to conduct a ***Ramp*** Audit on Vendor FWA located in Fort Wayne, IN on the ***American*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Fort Wayne, IN on the American continent and conducted the audit.
- It took you ***30 days*** to complete this audit.

[Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 5

*You are "Judy Smith" with **2 years** of experience.* You have been told to conduct a ***Line*** Audit on Vendor EWR located in Newark, NJ on the ***American*** continent.

Please use WebSAT to view the details of the past audits conducted on this vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the reports for previously conducted audits carefully.

[After reading the reports for previously conducted audits…]

Now, assume that

- You have traveled to Newark, NJ on the American continent and conducted the audit.
- It took you ***20 days*** to complete this audit.

[Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 6

Assume a base case that you are "Judy Smith" *with **2 years** of experience*. You have been told to conduct a ***Line*** Audit on Vendor EWR located in Newark, NJ on the ***American*** continent. Assume that you have traveled to Newark, NJ on the American continent and conducted the audit and it took you ***20 days*** to complete this audit.

WebSAT predicted a response rate of _____ for this audit.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting a **Supplier Audit** (instead of a Line Audit) on Vendor EWR. It takes you ***20 days*** to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 2

Assume everything else from the base case remains the same. However, it takes you ***35 days*** (instead of 20 days) to complete the ***Line*** Audit on Vendor EWR.

> [Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 3

Assume everything else from the base case remains the same. However, another auditor, Sanson, was sent to conduct the ***Line*** Audit, instead of you, on Vendor EWR. This auditor has **10 years experience** (instead of 2 years). It took him ***20 days*** to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 4

Assume everything else from the base case remains the same. However, it takes you **15 days** (instead of 20 days) to complete the ***Line*** Audit on Vendor EWR.

> [Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting a ***Line*** Audit on Vendor EWR located in **Brussels on the European continent** (instead of the American continent). It took you ***20 days*** to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 7

Assume a base case that you are "Judy Smith" *with **2 years** of experience*. You have been told to conduct a ***Line*** Audit on Vendor EWR located in Newark, NJ on the ***American*** continent. Assume that you have traveled to Newark, NJ on the American continent and conducted the audit and it took you ***20 days*** to complete this audit.

WebSAT predicted a response rate of _____ for this audit.
Please complete the following subtasks:

Sub Task 1

Everything else remaining the same, assume that you were conducting a **Supplier Audit** (instead of a Line Audit) on Vendor EWR.

> [Question] Considering all the above, use the ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 2

Everything else remaining the same, assume that it took you **35 days** to complete this audit.

> [Question] Considering all the above, use the ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 3

Everything else remaining the same, assume that another auditor, with **12 years experience**, was sent to conduct the audit.

> [Question] Considering all the above, use the ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 4

Everything else remaining the same, assume that it took you **5 days** to complete this audit.

> [Question] Considering all the above, use the ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 5

Everything else remaining the same, assume that you were conducting the audit on a vendor located **on the European continent**.

> [Question] Considering all the above use the ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Appendix U

Task Sheet- Internal Auditor

Introduction:

You will be reviewing and evaluating the utility and planning capability of the prediction model in the Web-based surveillance and auditing tool (WebSAT). This tool will allow you to store audit data, generate reports on stored data and conduct analysis using this data. The prediction model in this tool uses a statistical approach to analyze and interpret the historical data that was provided to us. This model can predict the response rate of an audit task. Response rate is the percentage of "Yes" responses received in an audit.

- The time for each session is about 1 hour.
- In this session, you will conduct two tests: Test I and Test II.
- Test I will contain six tasks and Test II will contain seven tasks.
- You will perform the same tasks for both the tests.
- Each task will require you to review preliminary data on an audit and its vendor. The tests will require you to review the vendor's history in WebSAT. The information to perform the task using this preliminary data will be provided in this task sheet.
- In Test I, you will be asked to predict a response rate at the end of each task. In one of the six tasks, you will be given five sub-tasks. In Test II, two of the seven tasks will ask you to predict a response rate using the available model within the WebSAT tool.
- You will be asked to complete a questionnaire to rate your satisfaction with the tool.

This session will assess the utility of the prediction model in WebSAT for end users such as auditors like you. You will be asked to "think-aloud," basically describing what you are doing, why you are doing it, and what you expect to happen while you are doing it. If you are having trouble with this, your observer will help by prompting you with appropriate questions when necessary.

I want you to remember that it is the tool that we are testing, and not you.

Keep in mind: Your opinion matters!

Do you have any questions at this point?

TEST I >>> Task 1

You are "Robin Steven" with userid *and* password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Aircraft Records*** Department belonging to Audit Type ***EMM***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***6*** days, if you were to predict the response rate of the department for ***Manuals*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 2

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Crew Planning*** Department belonging to Audit Type ***Flight OPS***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***50*** days, if you were to predict the response rate of the department for ***Safety*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 3

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Maintenance Programs*** Department belonging to Audit Type ***EMM***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***25*** days, if you were to predict the response rate of the department for ***Training*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 4

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Weather*** Department belonging to Audit Type ***Flight OPS***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***2*** days, if you were to predict the response rate of the department for ***Records*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 5

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Flight Safety*** Department belonging to Audit Type ***Flight OPS***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***25*** days, if you were to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST I >>> Task 6

Assume a **base case** that you have been told to conduct an audit at the ***Flight Safety*** Department. Assume that you have traveled to the department and conducted the audit and it took you ***25*** days to complete this audit.

You predicted a response rate of _____ for ***Procedures*** Process Measure for this audit.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting an audit on the ***Crew Resource Scheduling*** Department (instead of a Flight Safety Department). It took you ***25*** days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 2

Assume everything else from the base case remains the same. However, you took ***35*** **days** to complete this audit on the ***Flight Safety*** Department.

> [Question] Considering all the above, if you were to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 3

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25 days*** to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the department for ***Manuals*** Process Measure instead of Procedures Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 4

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25*** days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the department for **Training** Process Measure instead of Procedures Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST II >>> Task 1

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Aircraft Records*** Department belonging to Audit Type ***EMM***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***6*** days, use WebSAT to predict the response rate of the department for ***Manuals*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 2

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Crew Planning*** Department belonging to Audit Type ***Flight OPS***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***50*** days, use WebSAT to predict the response rate of the department for ***Safety*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 3

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Maintenance Programs*** Department belonging to Audit Type ***EMM***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***25*** days, use WebSAT to predict the response rate of the department for ***Training*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 4

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Weather*** Department belonging to Audit Type ***Flight OPS***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***2*** days, use WebSAT to predict the response rate of the department for ***Records*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 5

You are "Robin Steven" with userid and password "rs" and with 10 years of experience. You have been told to conduct an audit at the ***Flight Safety*** Department belonging to Audit Type ***Flight OPS***.

Please use WebSAT to view the details of the past audits conducted on this department. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the department for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

[Question] Considering all the above and assuming that the audit took ***25*** days, use WebSAT to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

Note: Response rate is the percentage number of "Yes" responses received in an audit.

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 6

Assume a base case that you have been told to conduct an audit at the ***Flight Safety*** Department belonging to Audit Type ***Flight OPS***. Assume that you have traveled to the department and conducted the audit and it took you ***25*** days to complete this audit.

WebSAT predicted a response rate of _____ for ***Procedures*** Process Measure for this audit.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting an audit on the ***Crew Resource Scheduling*** Department (instead of a Flight Safety Department). It took you ***25*** days to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 2

Assume everything else from the base case remains the same. However, you took **35 days** to complete this audit on the ***Flight Safety*** Department.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 3

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25*** days to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Manuals*** Process Measure instead of Procedures Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 4

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25*** days to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Training*** Process Measure instead of Procedures Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 7

Assume a base case that you have been told to conduct an audit at the ***Flight Safety*** Department. Assume that you have traveled to the department and conducted the audit and it took you ***25*** days to complete this audit.

WebSAT predicted a response rate of _____ for ***Procedures*** Process Measure for this audit.
Please complete the following subtasks:

Sub Task 1

Everything else remaining the same, assume that you were conducting an audit on the ***Crew Resource Scheduling*** Department (instead of a Flight Safety Department).

> [Question] Considering all the above, ***use Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 2

Everything else remaining the same, assume that you took ***35*** days to complete this audit.

> [Question] Considering all the above, ***use Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 3

Everything else remaining the same, if you were to predict the response rate of the department for ***Manuals*** Process Measure instead of Procedures Process Measure in this audit, what would it be? Use ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate.

Choose any one from below:

(a) Higher than that of Test II >> Task 7.
(b) Lower than that of Test II >> Task 7.
(c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 4

Everything else remaining the same, if you were to predict the response rate of the department for ***Training*** Process Measure instead of Procedures Process Measure in this audit, what would it be? Use ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate.

Choose any one from below:

(a) Higher than that of Test II >> Task 7.
(b) Lower than that of Test II >> Task 7.
(c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Appendix V

Task Sheet- Surveillance Representative

Introduction:

You will be reviewing and evaluating the utility and planning capability of the prediction model in the Web-based surveillance and auditing tool (WebSAT). This tool will allow you to store surveillance data, generate reports and conduct analysis. The prediction model in this tool uses a statistical approach to analyze and interpret the historical data that was provided to the WebSAT team. This model can predict the rejection rate of a surveillance task. Rejection rate is the probability of a "Reject" for a surveillance activity in a work order.

- The time for each session is about 1 hour.
- In this session, you will conduct two tests: Test I and Test II.
- Test I will contain six tasks and Test II will contain seven tasks.
- You will perform the same tasks for both the tests.
- Each task will require you to review preliminary data on an audit and its vendor. The tests will require you to review the vendor's history in WebSAT. The information to perform the task using this preliminary data will be provided in this task sheet.
- In Test I, you will be asked to predict a response rate at the end of each task. In one of the six tasks, you will be given five sub-tasks. In Test II, two of the seven tasks will ask you to predict a response rate using the available model within the WebSAT tool.
- You will be asked to complete a questionnaire to rate your satisfaction with the tool.

This session will assess the utility of the prediction model in WebSAT for end users such as surveillance representatives like you. You will be asked to "think-aloud," basically describing what you are doing, why you are doing it, and what you expect to happen while you are doing it. If you are having trouble with this, your observer will help by prompting you with appropriate questions when necessary.

I want you to remember that it is the tool that we are testing, and not you.

Keep in mind: Your opinion matters!

Do you have any questions at this point?

TEST I >>> Task 1

You are "Steve Johnson" and your userid ***and*** password is sj. You have been told to conduct a surveillance activity on aircraft 303 (***MD-10- 30F*** which is about ***33 years*** old) at Vendor BFM/MAE located in Mobile, AL on the ***American*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Mobile, AL on the American continent and conducted a surveillance activity.
- You were to perform an ***In Process*** Surveillance activity.

[Question] Considering all the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST I >>> Task 2

You have been told to conduct a surveillance activity for aircraft number 218 (a ***Boeing 727- 233*** about ***31 years*** old) on vendor ATS located in Seattle, WA on the ***American*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Seattle, WA on the American continent and conducted a surveillance activity.
- You were to perform an ***In Process*** Surveillance activity.

[Question] Considering all the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST I >>> Task 3

You have been told to conduct a surveillance activity for aircraft number 579 (a ***MD - 11*** about ***12 years*** old) on vendor located in Singapore on the ***Asian*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Singapore on the Asian continent and conducted a surveillance activity.
- You were to perform an ***In Process*** Surveillance activity.

[Question] Considering all the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST I >>> Task 4

You have been told to conduct a surveillance activity for aircraft number 188 (a ***Boeing 727*** about ***40 years*** old) on vendor located in Mobile, AL on ***American*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Mobile, AL on American continent and conducted a surveillance activity.
- You were to perform a ***Verification*** Surveillance activity.

[Question] Considering all the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST I >>> Task 5

You have been told to conduct a surveillance activity for aircraft number 717 (a ***Fokker*** about ***35 years*** old) on vendor located in Dresden on ***European*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Dresden on European continent and conducted a surveillance activity.
- You were to perform a ***Verification*** Surveillance activity.

[Question] Considering all the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST I >>> Task 6

Assume a base case that you were conducting a ***Verification*** Surveillance on a ***35 year*** old ***Fokker aircraft*** (tail # 717) at Dresden on the ***European*** continent.

You have predicted a probability of rejecting this activity at _____.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance on ***a younger Fokker*** aircraft aged ***5 years*** (instead of a 35 year old) at Dresden.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 2

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance ***at Greensboro, NC on the American Continent*** (instead of Dresden Europe).

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 3

Assume everything else from the base case remains the same. However, you are now conducting ***an In Process Surveillance*** - a different type of Technical Surveillance, instead of a Verification Surveillance at Dresden Europe.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 4

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance on ***an MD11*** (instead of a Fokker aircraft) aged 35 years at Dresden Europe.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting ***a Non Technical Surveillance such as Facility Surveillance activity*** instead of a Technical Surveillance such as Verification Surveillance at Dresden, Europe.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Representative's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST II >>> Task 1

You are "Representative_10". You have been told to conduct a surveillance activity on aircraft 303 (***MD - 10*** which is about ***33 years*** old) at Vendor BFM located in Mobile, AL on ***American*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Mobile, AL on American continent and conducted a surveillance activity.
- You were to perform an ***In Process*** Surveillance activity.

[Question] Considering all the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 2

You have been told to conduct a surveillance activity for aircraft number 218 (a ***Boeing 727- 233*** about ***31 years*** old) on vendor located in Seattle, WA on ***American*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Seattle, WA on American continent and conducted a surveillance activity.
- You were to perform an ***In Process*** Surveillance activity.

[Question] Considering all the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 3

You have been told to conduct a surveillance activity for aircraft number 579 (a ***MD - 11*** about ***35 years*** old) on vendor located in Singapore on ***Asian*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Singapore on Asian continent and conducted a surveillance activity.
- You were to perform an ***In Process*** Surveillance activity.

[Question] Considering all the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 4

You have been told to conduct a surveillance activity for aircraft number 188 (a ***Boeing 727*** about ***40 years*** old) on vendor located in Mobile, AL on ***American*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Mobile, AL on American continent and conducted a surveillance activity.
- You were to perform a ***Verification*** Surveillance activity.

[Question] Considering all the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 5

You have been told to conduct a surveillance activity for aircraft number 717 (a ***Fokker*** about ***35 years*** old) on vendor located in Dresden on ***European*** continent.

Please use WebSAT to view the past work orders and the representative's productivity on surveillance activities conducted on this vendor for this aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Now, assume that

- You have traveled to Dresden on European continent and conducted a surveillance activity.
- You were to perform a ***Verification*** Surveillance activity.

[Question] Considering all the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 6

Assume a base case that you were conducting a ***Verification*** Surveillance on a ***35 year old Fokker*** aircraft (tail # 717) at Dresden on the ***European*** continent.

WebSAT predicted a probability of rejecting this activity at _____.
Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance on ***a younger Fokker*** aircraft (A/C Tail # 777) aged ***5 years*** (instead of a 35 year old) at Dresden.

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 2

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance ***at Greensboro, NC in the American Continent*** (instead of Dresden Europe).

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 3

Assume everything else from the base case remains the same. However, you are now conducting ***an In Process Surveillance*** - a different type of Technical Surveillance, instead of a Verification Surveillance at Dresden Europe.

> [Question] Considering the above use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 4

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance on ***an MD11*** (A/C # 999) instead of a Fokker aircraft aged 35 years at Dresden Europe.

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting ***a Non Technical Surveillance such as Facility Surveillance activity*** instead of a Technical Surveillance such as Verification Surveillance at Dresden, Europe.

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 7

Assume a base case that you were conducting a ***Verification*** Surveillance on a ***35 year*** old Fokker aircraft (tail # 717) at Dresden on the ***European*** continent.

WebSAT predicted a probability of rejecting this activity at _____.
Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance on ***a younger 24 year old Fokker*** aircraft at Dresden

> [Question] Considering the above, use the ***Model Review Section*** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Representative's Prediction:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 2

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance ***on the American Continent*** instead of European continent.

> [Question] Considering the above, use the ***Model Review Section*** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Representative's Prediction:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 3

Assume everything else from the base case remains the same. However, you are now conducting ***an In Process Surveillance*** - a different type of Technical Surveillance, instead of a Verification Surveillance at Dresden Europe.

> [Question] Considering the above, use the ***Model Review Section*** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Representative's Prediction:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 4

Assume everything else from the base case remains the same. However, you are now conducting a Verification Surveillance on ***a MD 11*** (A/C # 579) instead of a Fokker aircraft aged 35 years at Dresden, Europe.

> [Question] Considering the above, use the ***Model Review Section*** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Representative's Prediction:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting ***a Non Technical Surveillance such as Facility Surveillance activity*** instead of a Technical Surveillance such as Verification Surveillance at Dresden, Europe.

> [Question] Considering the above, use the ***Model Review Section*** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Representative's Prediction:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Appendix W

Task Sheet- Technical Audit Manager

Introduction:

You will be reviewing and evaluating the utility and planning capability of the prediction model in the Web-based surveillance and auditing tool (WebSAT). This tool will allow you to store audit data, generate reports on stored data and conduct analysis using this data. The prediction model in this tool uses a statistical approach to analyze and interpret the historical data that was provided to us. This model can predict the response rate of an audit task. Response rate is the percentage of "Yes" responses received in an audit.

- The time for each session is about 1 hour.
- In this session, you will conduct two tests: Test I and Test II.
- Test I will contain six tasks and Test II will contain seven tasks.
- You will perform the same tasks for both the tests.
- Each task will require you to review preliminary data on an audit and its vendor. The tests will require you to review the vendor's history in WebSAT. The information to perform the task using this preliminary data will be provided in this task sheet.
- In Test I, you will be asked to predict a response rate at the end of each task. In one of the six tasks, you will be given five sub-tasks. In Test II, two of the seven tasks will ask you to predict a response rate using the available model within the WebSAT tool.
- You will be asked to complete a questionnaire to rate your satisfaction with the tool.

This session will assess the utility of the prediction model in WebSAT for end users such as auditors like you. You will be asked to "think-aloud," basically describing what you are doing, why you are doing it, and what you expect to happen while you are doing it. If you are having trouble with this, your observer will help by prompting you with appropriate questions when necessary.

I want you to remember that it is the tool that we are testing, and not you.

Keep in mind: Your opinion matters!

Do you have any questions at this point?

TEST I >>> Task 1

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(a) Auditor Sanson who has experience of 10 years;
(b) Auditor Judy S who has experience of 2 years;
(c) Auditor Bob C who has experience of 6 years

2) The vendor and audit type you would like to allocate is:

(a) Fuel Audit at Buffalo, NY;

3) Set Audit Duration as

(a) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to the above vendor for the audit duration specified that will give a high response rate.

For example, your allocation could be
(A) Auditor Sanson - Fuel Audit at Buffalo, NY - Duration 2 days
OR
(B) Auditor Judy S - Fuel Audit at Buffalo, NY - Duration 2 days

[Question] Considering all the above, if you were to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What are your reasons for the predicted response rate and allocation?*

TEST I >>> Task 2

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(a) Auditor Sanson who has experience of 10 years;
(b) Auditor Judy S who has experience of 2 years;
(c) Auditor Bob C who has experience of 6 years

2) The vendor and audit types you would like to allocate are:

(a) Airbus Avionics and Simulation Products - Supplier Audit at France;

3) Set Audit Durations as

(a) 35 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to the above vendor for the audit duration specified that will give a high response rate.
For example, your allocation could be

(A) Auditor Sanson - Airbus Avionics and Simulation Products Supplier Audit at France - Duration 35 days

OR

(B) Auditor Bob C - Airbus Avionics and Simulation Products Supplier Audit at France - Duration 35 days

[Question] Considering all the above, if you were to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:
(1)

Comments: *What are your reasons for the predicted response rate and allocation?*

TEST I >>> Task 3

You are the manager for the quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditor you have to allocate is:

(a) Auditor Bob C who has experience of 6 years

2) The vendors and audit types you would like to allocate are:

(a) Line Audit at EWR Newark, NJ;
(b) Fuel Audit at FBO Burlington, VT;

3) Set Audit Durations as

(a) 5 days

Please use WebSAT to view the details on the past audits conducted on the above vendors. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate the auditor to one of the above vendor for the audit duration specified that will give a high response rate.

For example, your allocation could be

(A) You chose Auditor Bob C - Line Audit at EWR Newark, NJ - Duration 5 days

OR

(B) You chose Auditor Bob C - Fuel Audit at Burlington, VT - Duration 5 days

[Question] Considering all the above, if you were to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What are your reasons for the predicted response rate and allocation?*

TEST I >>> Task 4

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(a) Auditor Bob C who has experience of 6 years

2) The vendors and audit types you would like to allocate are:

(a) Ramp Audit at Fort Wayne, IN;

3) Set Audit Durations for each combination as

(a) 2 days
(b) 35 days
(c) 20 days

Please use WebSAT to view the details on the past audits conducted on the above vendors. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate the auditor to the above vendor for one of the audit duration specified that will give a high response rate.

For example, your allocations could be
(A) Auditor Bob - Ramp Audit at Fort Wayne, IN - Duration 2 days
OR
(B) Auditor Bob - Ramp Audit at Fort Wayne, IN - Duration 20 days

[Question] Considering all the above, if you were to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What are your reasons for the predicted response rate and allocation?*

TEST I >>> Task 5

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(b) Auditor Judy S who has experience of 2 years;

2) The vendors and audit types you would like to allocate are:

(a) Line Audit Vendor EWR at Newark, NJ
(b) Line Audit at Narita, Japan;

3) Set Audit Durations for each combination as

(a) 20 days

Please use WebSAT to view the details on the past audits conducted on the above vendors. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate the auditor to one of the above vendor for the audit duration specified that will give a high response rate.

For example, your allocations could be
(A) Auditor Judy - EWR at Newark, NJ - Duration 20 days
OR
(B) Auditor Judy - Line Audit at Narita, Japan - Duration 20 days

[Question] Considering all the above, if you were to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What are your reasons for the predicted response rate and allocation?*

TEST I >>> Task 6

Assume a base case that you allocated "Judy Smith" *with 2 years of experience* to conduct a Line Audit on Vendor EWR located in Newark, NJ on the American continent. Assume that she has traveled to Newark, NJ on the American continent and conducted the audit and it took her 20 days to complete this audit.

Please predict a response rate for this audit:_____
OR
You predicted a response rate of _____ for this audit.

Please complete the following subtasks:

Sub Task 1
Assume everything else from the base case remains the same. However, you allocated a **Supplier Audit** (instead of a Line Audit) on Vendor EWR. It takes Judy 20 days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Manager's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 2
Assume everything else from the base case remains the same. However, it takes Judy, the auditor you allocated, **35 days** (instead of 20 days) to complete the Line Audit on Vendor EWR.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Manager's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 3

Assume everything else from the base case remains the same. However, another auditor, Sanson, was sent to conduct the Line Audit, instead of Judy, on Vendor EWR. This auditor has **10 years experience** (instead of 2 years). It took him 20 days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Manager's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 4

Assume everything else from the base case remains the same. However, it takes Judy, the auditor you allocated, **15 days** (instead of 20 days) to complete the Line Audit on Vendor EWR.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Manager's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting Judy to a Line Audit on Vendor EWR located in **Brussels on the European continent** (instead of the American continent). It took her 20 days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

Manager's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST II >>> Task 1

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(a) Auditor Sanson who has experience of 10 years;
(b) Auditor Judy S who has experience of 2 years;
(c) Auditor Bob C who has experience of 6 years

2) The vendor and audit type you would like to allocate is:

(a) Fuel Audit at Buffalo, NY;

3) Set Audit Duration as

(a) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to the above vendor for the audit duration specified.

For example, your allocation could be
(A) Auditor Sanson - Fuel Audit at Buffalo, NY - Duration 2 days
OR
(B) Auditor Judy G - Fuel Audit at Buffalo, NY - Duration 2 days

[Question] Considering all the above, if you were to use WebSAT to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 2

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(a) Auditor Sanson who has experience of 10 years;
(b) Auditor Judy S who has experience of 2 years;
(c) Auditor Bob C who has experience of 6 years

2) The vendor and audit types you would like to allocate are:

(a) Supplier Audit at France;

3) Set Audit Durations as

(a) 35 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to the above vendor for the audit duration specified.

For example, your allocation could be
(A) Auditor Sanson - Supplier Audit at France - Duration 35 days
OR
(B) Auditor Bob C - Supplier Audit at France - Duration 35 days

[Question] Considering all the above, if you were to use WebSAT to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 3

You are the manager for the quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditor you have to allocate is:

(a) Auditor Bob C who has experience of 6 years

2) The vendors and audit types you would like to allocate are:

(a) Line Audit at EWR Newark, NJ;
(c) Fuel Audit at FBO Burlington, VT;

3) Set Audit Durations as

(a) 5 days

Please use WebSAT to view the details on the past audits conducted on the above vendors. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to one of the above vendor for the audit duration specified.

For example, your allocation could be

(A) You chose Auditor Bob C - Line Audit at EWR Newark, NJ - Duration 5 days

OR

(B) You chose Auditor Bob C - Fuel Audit at Burlington, VT - Duration 5 days

[Question] Considering all the above, if you were to use WebSAT to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 4

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(a) Auditor Bob C who has experience of 6 years

2) The vendors and audit types you would like to allocate are:

(a) Ramp Audit at Fort Wayne, IN;

3) Set Audit Durations for each combination as

(a) 2 days
(b) 35 days
(c) 20 days

Please use WebSAT to view the details on the past audits conducted on the above vendors. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to the above vendor for one of the audit durations specified.

For example, your allocations could be
(A) Auditor Bob - Ramp Audit at Fort Wayne, IN - Duration 2 days
OR
(B) Auditor Bob - Ramp Audit at Fort Wayne, IN - Duration 20 days

[Question] Considering all the above if you were to use WebSAT to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 5

You are the manager for the Quality Assurance group of the Technical Audits Division. You would like to allocate audits in order to achieve high vendor performance from an audit.

1) Auditors you have to allocate are:

(b) Auditor Judy S who has experience of 2 years;

2) The vendors and audit types you would like to allocate are:

(a) Line Audit Vendor EWR at Newark, NJ
(b) Line Audit at Narita, Japan;

3) Set Audit Durations for each combination as

(a) 20 days

Please use WebSAT to view the details on the past audits conducted on the above vendors. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please allocate an auditor to one of the above vendor for the audit duration specified.

For example, your allocations could be
(A) Auditor Judy - EWR at Newark, NJ - Duration 20 days
OR
(B) Auditor Judy - Line Audit at Narita, Japan - Duration 20 days

[Question] Considering all the above if you were to use WebSAT to predict the response rate of the vendor for the audit allocation, what would it be? *Please make an allocation that will give a high response rate.*

Note: Response rate is the percentage number of "Yes" responses received in an audit.
Manager's Predicted Response Rate:

(1)

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 6

Assume a base case that you allocated "Judy Smith" *with 2 years of experience* to conduct a Line Audit on Vendor EWR located in Newark, NJ on the American continent. Assume that she has traveled to Newark, NJ on the American continent and conducted the audit and it took her 20 days to complete this audit.

Please use WebSAT to predict a response rate for this audit:_____
OR
WebSAT predicted a response rate of _____ for this audit.

Please complete the following subtasks:

Sub Task 1
Assume everything else from the base case remains the same. However, you allocated a **Supplier Audit** (instead of a Line Audit) on Vendor EWR to Judy who took 20 days to complete the audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 2
Assume everything else from the base case remains the same. However, it takes Judy, the auditor you allocated, **35 days** (instead of 20 days) to complete the Line Audit on Vendor EWR.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 3

Assume everything else from the base case remains the same. However, another auditor, Sanson, was sent to conduct the Line Audit, instead of Judy, on Vendor EWR. This auditor has **10 years experience** (instead of 2 years). It took him 20 days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 4

Assume everything else from the base case remains the same. However, it takes Judy, the auditor you allocated, **15 days** (instead of 20 days) to complete the Line Audit on Vendor EWR.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now conducting Judy to a Line Audit on Vendor EWR located in **Brussels on the European continent** (instead of the American continent). It took her 20 days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the vendor for this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 7

Assume a base case that you allocated "John B" *with 7 years of experience* to conduct a Line Audit on Vendor EWR located in Newark, NJ on the American continent. Assume that she has traveled to Newark, NJ on the American continent and conducted the audit and it took her 15 days to complete this audit.

Please use WebSAT to predict a response rate for this audit:_____
OR
WebSAT predicted a response rate of _____ for this audit.
Please complete the following subtasks:

Sub Task 1

Everything else remaining the same, assume that Judy was conducting a **Supplier Audit** (instead of a Line Audit) on Vendor EWR.

> [Question] Considering all the above, use WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 2

Everything else remaining the same, assume that it took Judy **35 days** to complete this audit.

> [Question] Considering all the above, use Model Review Section in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 3

Everything else remaining the same, assume that another auditor, with **12 years experience**, was sent to conduct the audit.

> [Question] Considering all the above, use Model Review Section in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 4

Everything else remaining the same, assume that it took Judy **5 days** to complete this audit.

> [Question] Considering all the above, use Model Review Section in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 5

Everything else remaining the same, assume that Judy was conducting the audit on a vendor located in the **European continent**.

> [Question] Considering all the above use Model Review Section in WebSAT's Audit Impact tool to predict the response rate of the vendor for this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Appendix X

Task Sheet- Internal Audit Manager

Introduction:

You will be reviewing and evaluating the utility and planning capability of the prediction model in the Web-based surveillance and auditing tool (WebSAT). This tool will allow you to store audit data, generate reports on stored data and conduct analysis using this data. The prediction model in this tool uses a statistical approach to analyze and interpret the historical data that was provided to us. This model can predict the response rate of an audit task. Response rate is the percentage of "Yes" responses received in an audit.

- The time for each session is about 1 hour.
- In this session, you will conduct two tests: Test I and Test II.
- Test I will contain six tasks and Test II will contain seven tasks.
- You will perform the same tasks for both the tests.
- Each task will require you to review preliminary data on an audit and its vendor. The tests will require you to review the vendor's history in WebSAT. The information to perform the task using this preliminary data will be provided in this task sheet.
- In Test I, you will be asked to predict a response rate at the end of each task. In one of the six tasks, you will be given five sub-tasks. In Test II, two of the seven tasks will ask you to predict a response rate using the available model within the WebSAT tool.
- You will be asked to complete a questionnaire to rate your satisfaction with the tool.

This session will assess the utility of the prediction model in WebSAT for end users such as auditors like you. You will be asked to "think-aloud," basically describing what you are doing, why you are doing it, and what you expect to happen while you are doing it. If you are having trouble with this, your observer will help by prompting you with appropriate questions when necessary.

I want you to remember that it is the tool that we are testing, and not you.

Keep in mind: Your opinion matters!

Do you have any questions at this point?

TEST I >>> Task 1

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) EMM- Aircraft Records

2) The Process Measure:

(a) Manuals

3) The Audit duration:
(a) 6 days
(b) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Aircraft records- Manuals - 6 days

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 2

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) Flight Operations- Crew Planning

2) The Process Measure:

(a) Administration
(b) Safety

3) The Audit duration:
(a) 50 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Crew Planning - Administration - 50 days

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 3

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) EMM- Maintenance Programs

2) The Process Measure:

(a) Training

3) The Audit duration:
(a) 25 days
(b) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Maintenance Programs - Training - 25 days

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 4

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) Flight OPs - Weather

2) The Process Measure:

(a) Records
(b) Procedures

3) The Audit duration:
(a) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Weather - Procedures - 2 days

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 5

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) Flight OPs - Flight Safety

2) The Process Measure:

(a) Procedures
(b) Training

3) The Audit duration:
(a) 25 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Flight Safety- Training - 25 days

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 6

Assume a **base case** that you have been told to conduct an audit at the ***Flight Safety*** Department. Assume that you have traveled to the department and conducted the audit and it took you ***25*** days to complete this audit.

You predicted a response rate of _____ for ***Procedures*** Process Measure for this audit.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting an audit on the ***Crew Resource Scheduling*** Department (instead of a Flight Safety Department). It took you ***25*** days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 2

Assume everything else from the base case remains the same. However, you took ***35*** **days** to complete this audit on the ***Flight Safety*** Department.

> [Question] Considering all the above, if you were to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 3

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25 days*** to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the department for ***Manuals*** Process Measure instead of Procedures Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

Sub Task 4

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25*** days to complete this audit.

> [Question] Considering all the above, if you were to predict the response rate of the department for **Training** Process Measure instead of Procedures Process Measure in this audit, what would it be?

Auditor's Predicted Response Rate:

Comments: *What are your reasons for the predicted response rate?*

TEST II >>> Task 1

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) EMM- Aircraft Records

2) The Process Measure:

(a) Manuals

3) The Audit duration:
(a) 6 days
(b) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Aircraft Records- Manuals - 6 days

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 2

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) Flight Operations- Crew Planning

2) The Process Measure:

(a) Administration
(b) Safety

3) The Audit duration:
(a) 50 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Crew Planning - Administration - 50 days

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 3

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) EMM- Maintenance Programs

2) The Process Measure:

(a) Training

3) The Audit duration:
(a) 25 days
(b) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Maintenance Programs - Training - 25 days

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 4

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) Flight OPs - Weather

2) The Process Measure:

(a) Records
(b) Procedures

3) The Audit duration:
(a) 2 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Weather - Procedures - 2 days

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 5

You are the manager - Mike Iman (user ID and password - mi) for the Quality Assurance group of the Internal Division. You would like to plan your Internal Audits.

1) Audit Type and department you have to review:

(a) Flight OPs - Flight Safety

2) The Process Measure:

(a) Procedures
(b) Training

3) The Audit duration:
(a) 25 days

Please use WebSAT to view the details on the past audits conducted on the above vendor. These details include date of the audit, duration of the audit, audit checklist with completed responses, audit findings (if any) and various corrective actions provided by the vendor for each finding.

You may take your time to review the past audits carefully.

[After reading the previously conducted audit reports…]

Please plan the combinations of the above parameters with low response rate.

For example, you could choose
(1) Flight Safety- Training - 25 days

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with highest response rate.

Note:
Manager's Predicted Response:

(1)

Comments: *What are your reasons for choosing the combination?*

Test II>> Task 6

Assume a base case that you have been told to conduct an audit at the ***Flight Safety*** Department belonging to Audit Type ***Flight OPS***. Assume that you have traveled to the department and conducted the audit and it took you ***25*** days to complete this audit.

WebSAT predicted a response rate of _____ for ***Procedures*** Process Measure for this audit.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now conducting an audit on the ***Crew Resource Scheduling*** Department (instead of a Flight Safety Department). It took you ***25*** days to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 2

Assume everything else from the base case remains the same. However, you took **35 days** to complete this audit on the ***Flight Safety*** Department.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 3

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25*** days to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Manuals*** Process Measure instead of Procedures Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 4

Assume everything else from the base case remains the same i.e. you are conducting an audit on the ***Flight Safety*** Department. It took you ***25*** days to complete this audit.

> [Question] Considering all the above, use WebSAT to predict the response rate of the department for ***Training*** Process Measure instead of Procedures Process Measure in this audit, what would it be?

WebSAT's Predicted Response Rate:

Comments: *What is your reaction to WebSAT's prediction?*

Test II>> Task 7

Assume a base case that you have been told to conduct an audit at the ***Flight Safety*** Department. Assume that you have traveled to the department and conducted the audit and it took you ***25*** days to complete this audit.

WebSAT predicted a response rate of _____ for ***Procedures*** Process Measure for this audit.
Please complete the following subtasks:

Sub Task 1

Everything else remaining the same, assume that you were conducting an audit on the ***Crew Resource Scheduling*** Department (instead of a Flight Safety Department).

> [Question] Considering all the above, ***use Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 2

Everything else remaining the same, assume that you took ***35*** days to complete this audit.

> [Question] Considering all the above, ***use Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate of the department for ***Procedures*** Process Measure in this audit, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 3

Everything else remaining the same, if you were to predict the response rate of the department for ***Manuals*** Process Measure instead of Procedures Process Measure in this audit, what would it be? Use ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate.

Choose any one from below:

(a) Higher than that of Test II >> Task 7.
(b) Lower than that of Test II >> Task 7.
(c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 4

Everything else remaining the same, if you were to predict the response rate of the department for ***Training*** Process Measure instead of Procedures Process Measure in this audit, what would it be? Use ***Model Review Section*** in WebSAT's Audit Impact tool to predict the response rate.

Choose any one from below:

(a) Higher than that of Test II >> Task 7.
(b) Lower than that of Test II >> Task 7.
(c) Same as of Test II >> Task 7.

Auditor's choice:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Appendix Y

Task Sheet- Surveillance Manager

Introduction:

You will be reviewing and evaluating the utility and planning capability of the prediction model in the Web-based surveillance and auditing tool (WebSAT). This tool will allow you to store surveillance data, generate reports and conduct analysis. The prediction model in this tool uses a statistical approach to analyze and interpret the historical data that was provided to the WebSAT team. This model can predict the rejection rate of a surveillance task. Rejection rate is the probability of a "Reject" for a surveillance activity in a work order.

- The time for each session is about 1 hour.
- In this session, you will conduct two tests: Test I and Test II.
- Test I will contain six tasks and Test II will contain seven tasks.
- You will perform the same tasks for both the tests.
- Each task will require you to review preliminary data on an audit and its vendor. The tests will require you to review the vendor's history in WebSAT. The information to perform the task using this preliminary data will be provided in this task sheet.
- In Test I, you will be asked to predict a response rate at the end of each task. In one of the six tasks, you will be given five sub-tasks. In Test II, five of the seven tasks will ask you to predict a response rate using the available model within the WebSAT tool.
- You will be asked to complete a questionnaire to rate your satisfaction with the tool.

This session will assess the utility of the prediction model in WebSAT for end users such surveillance representatives like you. You will be asked to "think-aloud," basically describing what you are doing, why you are doing it, and what you expect to happen while you are doing it. If you are having trouble with this, your observer will help by prompting you with appropriate questions when necessary.

I want you to remember that it is the tool that we are testing, and not you.

Keep in mind: Your opinion matters!

Do you have any questions at this point?

TEST I >>> Task 1

You are the manager - Jim Martin (user ID and password - jm) for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve vendor performance on rejection rate for a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 188- a Boeing 727 of 40 years;
(b) Aircraft tail number 579- a MD-11 of 12 years;

2) The vendors you have to review are:

(a) Vendor in Dresden, Germany Europe.

3) The Process Measures are:

(b) Final Walkaround

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 188- Vendor Dresden in Germany - for a Final Walkaround

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
Manager's Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 2

You are the manager for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve high vendor performance from a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 218- a Boeing 727 of 40 years;
(b) Aircraft tail number 303- a MD-10-30F of 33 years;

2) The vendor you have to review is:

(a) Vendor TIMCO in Greensboro, NC

3) The Process Measure is:

(a) Facility Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 218- Vendor TIMCO - for a Facility Surveillance
(2) Aircraft tail number 303- Vendor TIMCO - for a Facility Surveillance

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
Manager's Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 3

You are the manager for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve high vendor performance from a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 360- a MD10 of 10 years;
(b) Aircraft tail number 434- an Airbus 310 of 22 years;

2) The vendor you have to review is:

(a) Vendor BFM in Mobile, Al

3) The Process Measure is:

(a) Verification Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 360- Vendor BFM - for a Verification Surveillance
(2) Aircraft tail number 434- Vendor BFM - for a Verification Surveillance

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
Manager's Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 4

You are the manager for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve high vendor performance from a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 618- a MD11 of 11 years;

2) The vendor you have to review is:

(a) Vendor SASCO in Singapore

3) The Process Measure is:

(a) Documentation Surveillance
(b) Facility Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 618- Vendor SASCO - for a Facility Surveillance
OR (2) Aircraft tail number 618- Vendor SASCO - for a Documentation Surveillance

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
Manager's Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 5

You are the manager - Jim Martin (user ID and password - jm) for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve vendor performance on rejection rate for a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 717- a Fokker of 35 years;

2) The vendors you have to review:

(a) Vendor in Dresden, Germany Europe.

3) The Process Measures are:

(a) Procedures Manual Violation
(b) Verification Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters in a descending order of rejection rate.

For example, you could choose
(1) Aircraft tail number 717- Vendor in Dresden, Germany Europe - for a Procedures Manual Violation

[Question] Considering all the above, please predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
Manager's Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST I >>> Task 6

Assume a base case that you were reviewing a Verification Surveillance on a 35 year old Fokker aircraft (tail # 717) at Dresden on the European continent.

Please predict a probability of rejecting this activity at _____.
OR
You have predicted a probability of rejecting this activity at _____.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance on ***a younger Fokker*** aircraft aged 5 years (instead of a 35 year old) at Dresden.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Manager's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 2

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance ***at Greensboro, NC in the American Continent*** (instead of Dresden Europe).

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Manager's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 3

Assume everything else from the base case remains the same. However, you are now reviewing ***an In Process Surveillance*** - a different type of Technical Surveillance, instead of a Verification Surveillance at Dresden Europe.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Manager's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 4

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance on ***an MD11*** (instead of a Fokker aircraft) aged 35 years at Dresden Europe.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Manager's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now reviewing ***a Non Technical Surveillance such as Facility Surveillance activity*** instead of a Technical Surveillance such as Verification Surveillance at Dresden, Europe.

> [Question] Considering the above, if you were to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

Manager's Predicted Rejection:

Comments: *What are your reasons for the predicted rejection rate?*

TEST II >>> Task 1

You are the manager - Jim Martin (user ID and password - jm) for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve vendor performance on rejection rate for a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 188- a Boeing 727 of 40 years;
(b) Aircraft tail number 579- a MD-11 of 12 years;

2) The vendors you have to review are:

(a) Vendor in Dresden, Germany Europe.

3) The Process Measures are:

(b) Final Walkaround

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 188- Vendor Dresden in Germany - for a Final Walkaround

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
WebSAT Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 2

You are the manager for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve high vendor performance from a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 218- a Boeing 727 of 40 years;
(b) Aircraft tail number 303- a MD-10 - 30F of 35 years;

2) The vendors you have to review are:

(a) Vendor TIMCO in Greensboro, NC

3) The Process Measures are:

(a) Facility Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 218- Vendor TIMCO - for a Facility Surveillance
(2) Aircraft tail number 303- Vendor Dresden - for a Facility Surveillance

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
WebSAT Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 3

You are the manager - Jim Martin (user ID and password - jm) for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve vendor performance on rejection rate for a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 360- a MD10 of 10 years;
(b) Aircraft tail number 434- an Airbus 310 of 22 years;

2) The vendor you have to review is:

(a) Vendor BFM in Mobile, Al

3) The Process Measure is:

(a) Verification Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 360- Vendor BFM - for a Verification Surveillance
OR (2) Aircraft tail number 434- Vendor BFM - for a Verification Surveillance

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
WebSAT Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 4

You are the manager for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve high vendor performance from a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 618- a MD11 of 11 years;

2) The vendor you have to review is:

(a) Vendor SASCO in Singapore

3) The Process Measure is:

(a) Documentation Surveillance
(b) Facility Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters with low rejection rate.

For example, you could choose
(1) Aircraft tail number 618- Vendor SASCO - for a Facility Surveillance
OR (2) Aircraft tail number 618- Vendor SASCO - for a Documentation Surveillance

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
WebSAT Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 5

You are the manager - Jim Martin (user ID and password - jm) for the Quality Assurance group of the Surveillance Division. You would like to plan your surveillance in order to achieve vendor performance on rejection rate for a surveillance activity.

1) Aircraft you have to review:

(a) Aircraft tail number 717- a Fokker of 35 years;

2) The vendors you have to review are:

(a) Vendor in Dresden, Germany Europe.

3) The Process Measures are:

(a) Procedures Manual Violation
(b) Verification Surveillance

Please use WebSAT to view the past work orders and the representatives' productivity on surveillance activities conducted on the above mentioned vendors and aircraft. These details include date of the work order, activities completed and findings (if any).

You may take your time to review the past work orders carefully.

[After reading the previously conducted work orders…]

Please plan the combinations of the above parameters in a descending order of rejection rate.

For example, you could choose

(1) Aircraft tail number 717- Vendor in Dresden, Germany Europe - for a Procedures Manual Violation

[Question] Considering all the above, please use WebSAT to predict the probability of rejecting the activity in each combination and list the combination below with lowest rejection rate.

Note: (Scale - 0 to 1) The closer the number is to 1, this higher the chances for a rejection.
WebSAT Predicted Rejection:

(1)

Comments: *What are your reasons for choosing the combination?*

TEST II >>> Task 6

Assume a base case that you were reviewing a Verification Surveillance on a 35 year old Fokker aircraft (tail # 717) at Dresden on the European continent.

Please use WebSAT to predict a probability of rejecting this activity at _____.
OR
WebSAT predicted a probability of rejecting this activity at _____.

Please complete the following subtasks:

Sub Task 1

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance on ***a younger Fokker*** aircraft (A/C Tail # 777) aged 5 years (instead of a 35 year old) at Dresden.

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 2

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance ***at Greensboro, NC in the American Continent*** (instead of Dresden Europe).

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 3

Assume everything else from the base case remains the same. However, you are now reviewing ***an In Process Surveillance*** - a different type of Technical Surveillance, instead of a Verification Surveillance at Dresden Europe.

> [Question] Considering the above use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 4

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance on ***an MD11*** (A/C # 579) instead of a Fokker aircraft aged 35 years at Dresden Europe.

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

Sub Task 5

Assume everything else from the base case remains the same. However, you are now reviewing ***a Non Technical Surveillance such as Facility Surveillance activity*** instead of a Technical Surveillance such as Verification Surveillance at Dresden, Europe.

> [Question] Considering the above, use WebSAT to predict the probability of rejecting this activity, what would it be?

Note: (Scale - 0 to 1) The closer the number is to 1, the higher the chances for a rejection.

WebSAT's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

TEST II >>> Task 7

Assume a base case that you were reviewing a Verification Surveillance on a 35 year old Fokker aircraft (tail # 717) at Dresden on the European continent.

Please use WebSAT to predict a probability of rejecting this activity at _____.
OR
WebSAT predicted a probability of rejecting this activity at _____.
Please complete the following subtasks:

Sub Task 1
Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance on ***a younger 5 year old Fokker*** aircraft at Dresden

> [Question] Considering the above, use the ***Model Review Section*** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 2
Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance ***on the American Continent*** instead of European continent.

> [Question] Considering the above, use the **Model Review Section** in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 3

Assume everything else from the base case remains the same. However, you are now reviewing ***an In Process Surveillance*** - a different type of Technical Surveillance, instead of a Verification Surveillance at Dresden Europe.

> [Question] Considering the above, use the Model Review Section in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 4

Assume everything else from the base case remains the same. However, you are now reviewing a Verification Surveillance on ***a MD 11*** (A/C # 999) instead of a Fokker aircraft aged 35 years at Dresden, Europe.

> [Question] Considering the above, use the Model Review Section in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Sub Task 5

Assume everything else from the base case remains the same. However, you are now reviewing ***a Non Technical Surveillance such as Facility Surveillance activity*** instead of a Technical Surveillance such as Verification Surveillance at Dresden, Europe.

> [Question] Considering the above, use the Model Review Section in WebSAT's Surveillance Planning tool to predict the probability of rejecting this activity, what would it be? Choose any one from below:
>
> (a) Higher than that of Test II >> Task 7.
> (b) Lower than that of Test II >> Task 7.
> (c) Same as of Test II >> Task 7.

Manager's Predicted Rejection:

Comments: *What is your reaction to WebSAT's prediction?*

What is your comment on the model review and its graphs?

Appendix Z

SUMI Analysis

(A) Technical Audit Module

1. Technical Auditor Data:

(i) Scores on Six Usability scales

Scale	UF	Ucl	Medn	Lcl	LF
Global	73	76	73	70	73
Efficiency	74	69	68	67	65
Affect	71	75	71	67	71
Helpfulness	71	73	71	70	71
Control	71	78	71	65	71
Learnability	71	72	71	69	71

(ii) Individual scores as obtained from the participants

Participant	Global	Efficiency	Affect	Helpfulness	Control	Learnability
1	65	71	60	67	53	66
2	73	68	71	71	71	71
3	73	68	71	71	71	71
4	73	71	71	71	71	71
5	73	68	71	71	71	71

2. Auditing Manager Data:
(i) Scores on Six Usability scales

Scale	UF	Ucl	Medn	Lcl	LF
Global	0	0	62	0	0
Efficiency	0	0	61	0	0
Affect	0	0	59	0	0
Helpfulness	0	0	61	0	0
Control	0	0	56	0	0
Learnability	0	0	60	0	0

(ii) Individual scores as obtained from the participants

User	Global	Efficiency	Affect	Helpfulness	Control	Learnability
1	65	71	60	67	53	66
2	59	50	58	54	60	54

With less than 4 users, Confidence Intervals, and Fences, are not calculated.

(B) Internal Audit Module

1. Internal Auditor Data:

(i) Scores on Six Usability scales

Scale	UF	Ucl	Medn	Lcl	LF
Global	74	67	63	60	55
Efficiency	66	61	57	54	48
Affect	79	66	59	52	42
Helpfulness	73	66	61	57	53
Control	71	69	65	62	57
Learnability	76	67	62	57	50

(ii) Individual scores as obtained from the participants

User	Global	Efficiency	Affect	Helpfulness	Control	Learnability
1	65	61	56	71	65	71
2	70	59	71	60	67	60
3	62	56	52	60	58	57
4	61	52	61	62	66	64

(B) Auditing Manager Data:
(i) Scores on Six Usability scales: Profile Analysis is not carried out with only one user.

(ii) Individual Scores as obtained from the participants

User	Global	Efficiency	Affect	Helpfulness	Control	Learnability
1	64	64	59	65	65	68

With less than 4 users, Confidence Intervals, and Fences, are not calculated.

(C) Surveillance Module

1. Surveillance Representative Data:

(i) Scores on Six Usability scales

Scale	UF	Ucl	Medn	Lcl	LF
Global	74	71	70	69	63
Efficiency	77	68	65	63	59
Affect	66	62	60	59	57
Helpfulness	72	69	67	65	61
Control	75	71	69	67	57
Learnability	76	70	68	66	59

(ii) Individual scores as obtained from the participants

User	Global	Efficiency	Affect	Helpfulness	Control	Learnability
1	67	65	63	62	63	62
2	70	65	60	69	69	71
3	71	71	60	67	69	68
4	71	71	60	67	69	68
5	67	61	65	67	63	71
6	67	65	63	62	63	62
7	70	65	60	69	69	71
8	71	71	60	67	69	68

3. Surveillance Manager Data:
(i) Scores on Six Usability scales

Scale	UF	Ucl	Medn	Lcl	LF
Global	0	0	63	0	0
Efficiency	0	0	64	0	0
Affect	0	0	59	0	0
Helpfulness	0	0	61	0	0
Control	0	0	57	0	0
Learnability	0	0	62	0	0

(ii) Individual scores as obtained from the participants

User	Global	Efficiency	Affect	Helpfulness	Control	Learnability
1	64	71	58	63	59	68
2	59	49	58	54	60	54
3	65	71	60	67	53	66

With less than 4 users, Confidence Intervals, and Fences, are not calculated.

Interpretation of scores as presented in SUMISCO:

The Median is the middle score when the scores are arranged in numerical order. It is the indicative sample statistic for each usability scale.

The Ucl and Lcl are the Upper and Lower Confidence Limits. They represent the limits within which the theoretical true score lies 95% of the time for this sample of users.

The UF and LF are the Upper and Lower Fences. They represent values beyond which it may be plausibly suspected that a user is not responding with the rest of the group: the user may be responding with an outlier.

Appendix AA

Feedback Questionnaire and Time Results

Results for WebSAT without the model - Feedback Questionnaire

Participants	C1	C2	C3	C4	C5	C6	
1	4	4	5	3	3	3	
2	4	5	5	3	3	4	
3	5	4	5	3	4	4	
4	5	5	5	3	4	3	
5	4	4	4	3	3	4	
6	6	5	5	3	4	4	
7	4	6	5	3	3	4	
8	4	4	5	3	3	3	
9	5	4	4	4	4	3	
10	4	4	5	3	4	4	
11	6	5	5	3	4	3	
12	4	4	5	3	4	4	
13	4	4	5	3	4	4	
14	5	4	4	3	4	4	
15	4	4	5	2	3	3	
16	4	4	5	4	4	4	
17	6	6	4	2	3	4	
18	4	4	5	3	3	4	
19	5	5	5	3	3	3	
20	4	4	4	4	4	4	
21	4	5	4	3	3	4	
22	6	4	4	4	3	3	
23	4	4	5	3	3	3	
MEAN	4.57	4.43	4.70	3.09	3.48	3.61	
					MEAN		3.98

Results for WebSAT with the model- Feedback Questionnaire

Participants	C1	C2	C3	C4	C5	C6
1	4	4	5	5	6	4
2	4	5	5	4	4	5
3	6	4	5	5	6	5
4	5	5	5	5	4	4
5	4	4	4	4	6	5
6	6	5	5	4	4	4
7	4	6	5	5	4	5
8	4	4	5	4	5	4
9	5	4	6	4	5	4
10	4	4	5	5	4	6
11	6	5	5	4	4	3
12	4	4	5	5	4	4
13	4	4	5	5	5	4
14	5	4	4	5	4	6
15	4	4	5	6	5	6
16	4	4	5	5	5	4
17	6	6	4	5	4	4
18	4	4	5	4	3	6
19	5	5	5	4	5	3
20	4	4	4	5	5	5
21	4	5	4	6	4	5
22	6	4	4	4	6	4
23	5	5	5	4	5	6
MEAN	4.65	4.48	4.78	4.65	4.65	4.61
					MEAN	4.64

Results for WebSAT without and with the model - Experiment Time

	Without the model			With the model		
Participants	M1	M2	M3	M1	M2	M3
1	3.20	4.80	3.20	0.80	1.11	0.80
2	3.00	2.60	3.00	0.78	1.13	0.78
3	1.20	1.72	1.20	0.67	1.07	0.67
4	2.57	2.89	2.57	0.90	1.24	0.90
5	0.89	1.72	0.89	0.90	1.19	0.90
6	0.85	3.20	0.85	0.75	0.80	0.75

	Without the model			With the model		
Participants	**M1**	**M2**	**M3**	**M1**	**M2**	**M3**
7	0.91	1.60	0.91	0.39	0.76	0.39
8	1.35	3.67	1.35	0.33	0.64	0.33
9	0.95	1.63	0.95	0.68	0.80	0.68
10	0.93	3.00	0.93	0.86	0.55	0.86
11	2.50	5.40	2.50	1.00	1.93	1.00
12	0.83	6.00	0.83	1.25	1.27	1.25
13	1.65	5.94	1.65	1.13	1.46	1.13
14	1.74	4.25	1.74	1.11	1.39	1.11
15	0.78	4.88	0.78	0.95	3.14	0.95
16	1.06	4.08	1.06	0.79	1.44	0.79
17	0.82	4.18	0.82	0.77	1.67	0.77
18	0.63	3.34	0.63	0.89	3.34	0.89
19	0.39	3.38	0.39	0.78	1.76	0.78
20	0.53	2.52	0.53	0.71	1.83	0.71
21	2.40	3.40	2.40	0.81	1.23	0.81
22	1.96	3.20	1.96	0.75	1.17	0.75
23	1.50	4.67	1.50	0.93	1.15	0.93
MEAN	1.42	3.57	1.42	0.82	1.39	0.82

Legend for the tables above

Legend	
Easy retrieval of audit information	C1
Availability of important audit information	C2
Reduction of non-value-added activities during audit information review	C3
Ability to predict response / rejection rates	C4
Ability to assess risk factors and their impact	C5
Ability to view historical information graphically	C6
Time taken to generate useful information for future maintenance and audits.	M1
Time taken to analyze vendor/ department performance	M2
Time to identify risk factors.	M3

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